

Appendix 11. North Delta Diversion Rule Curve Optimization

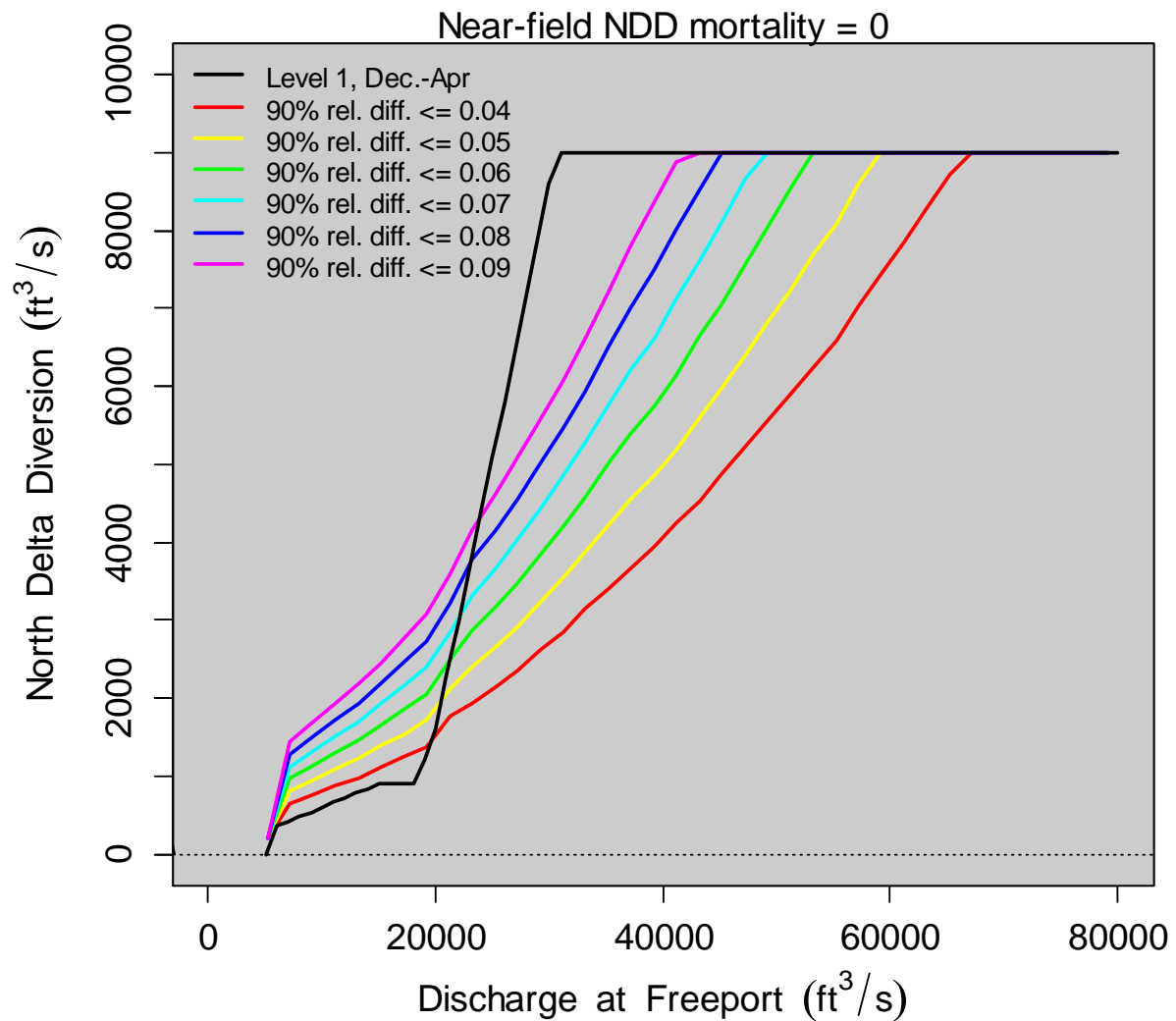


Figure 11.1. Graph showing NDD rates as a functions of Sacramento River discharge required to achieve a 90% probability of a given relative decrease in survival assuming zero near-field mortality.

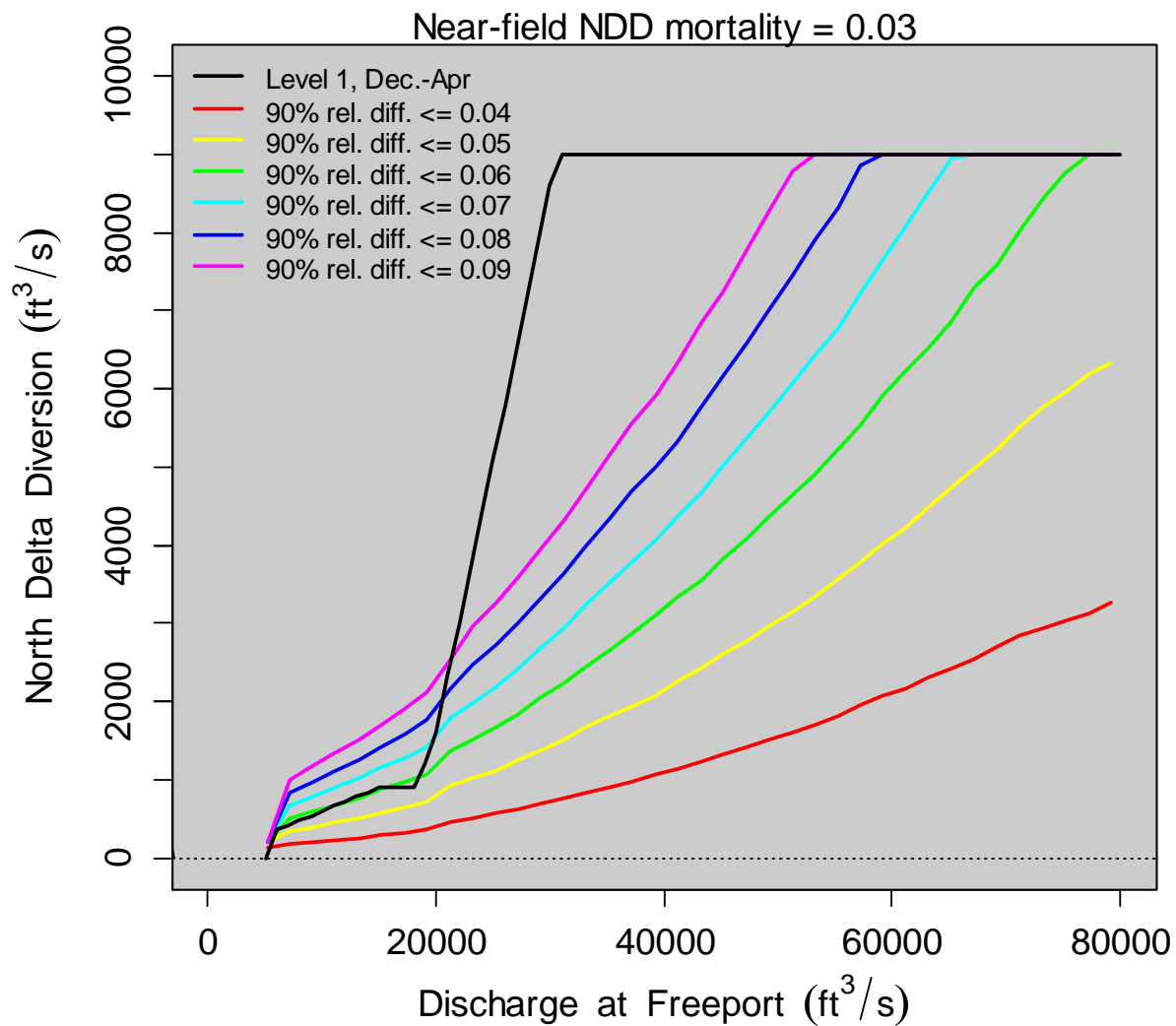


Figure 11.2. Graph showing NDD rates as a functions of Sacramento River discharge required to achieve a 90% probability of a given relative decrease in survival assuming near-field mortality of 0.03.

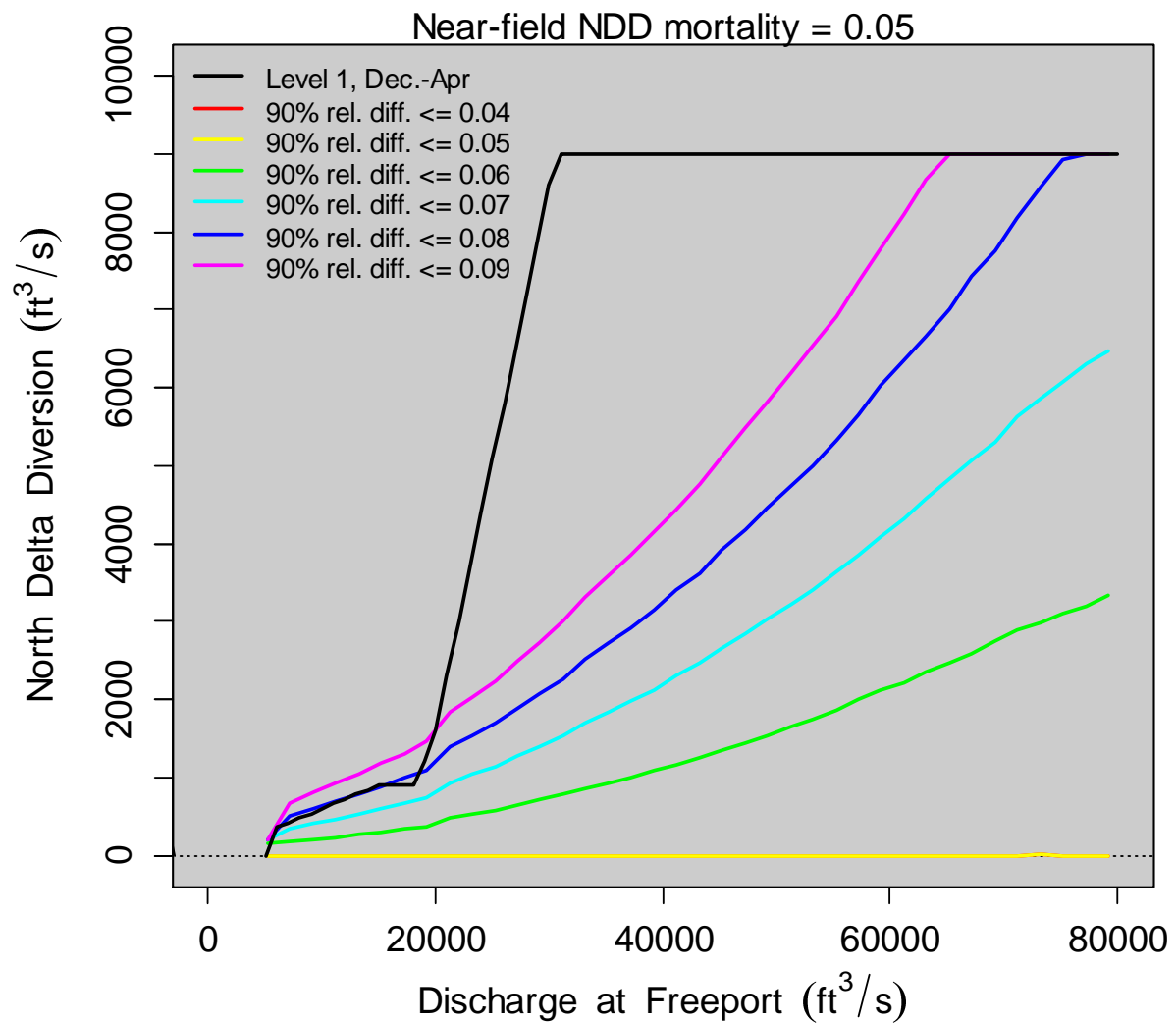


Figure 11.3. Graph showing NDD rates as a functions of Sacramento River discharge required to achieve a 90% probability of a given relative decrease in survival assuming near-field mortality of 0.05.

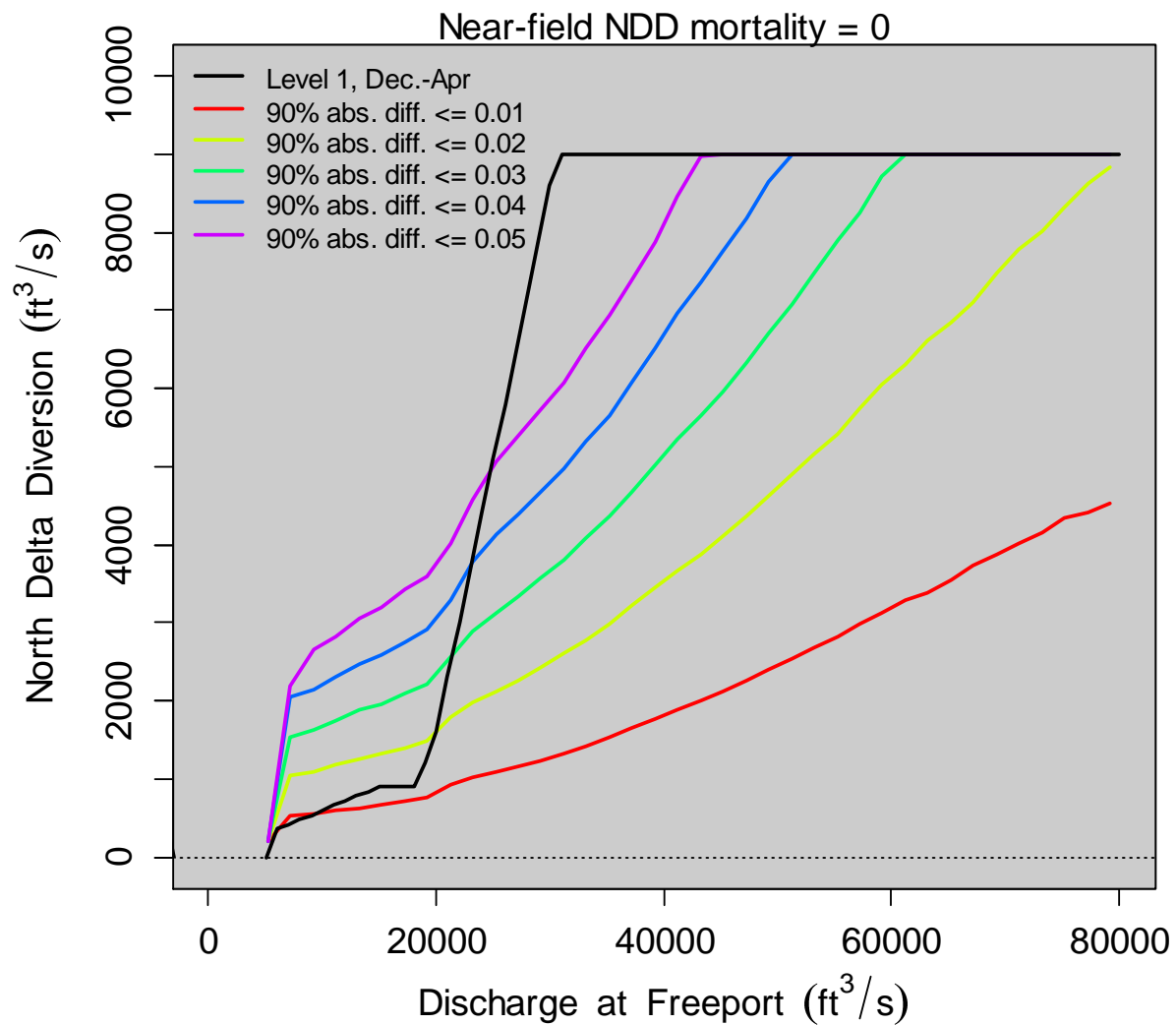


Figure 11.4. Graph showing NDD rates as a functions of Sacramento River discharge required to achieve a 90% probability of a given absolute decrease in survival assuming zero near-field mortality.

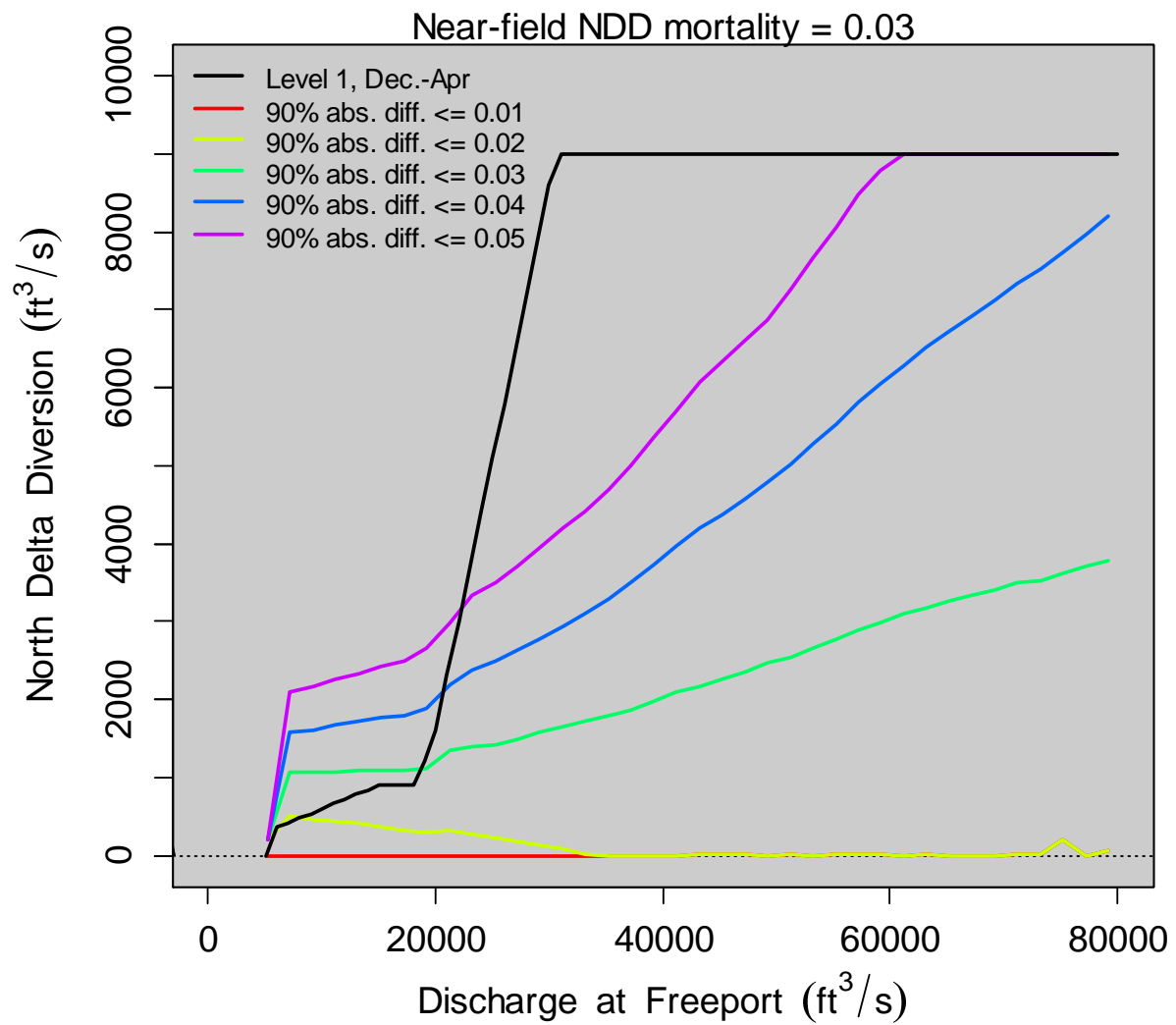


Figure 11.5. Graph showing NDD rates as a functions of Sacramento River discharge required to achieve a 90% probability of a given absolute decrease in survival assuming near-field mortality of 0.03.

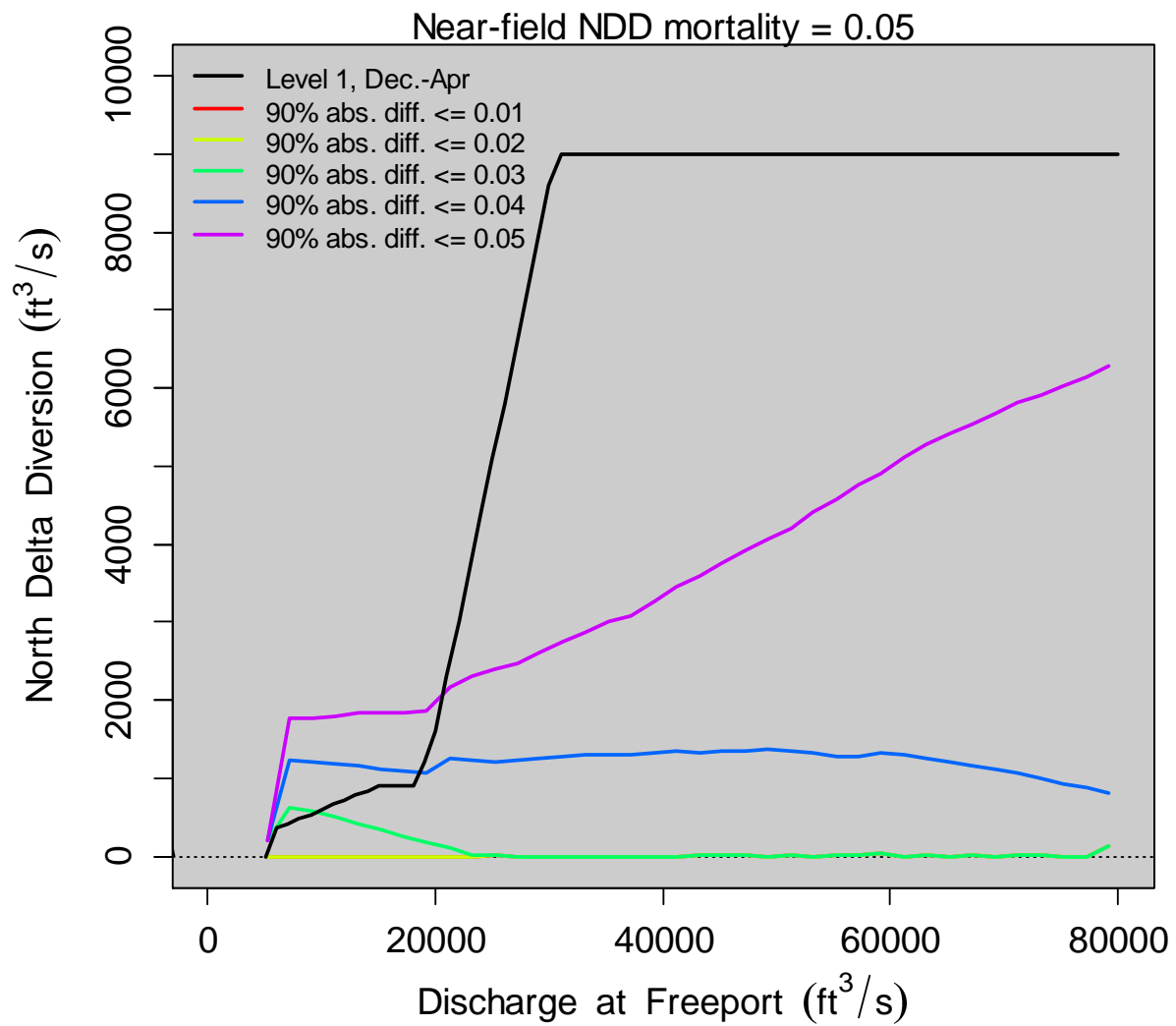


Figure 11.6. Graph showing NDD rates as a functions of Sacramento River discharge required to achieve a 90% probability of a given absolute decrease in survival assuming near-field mortality of 0.05.

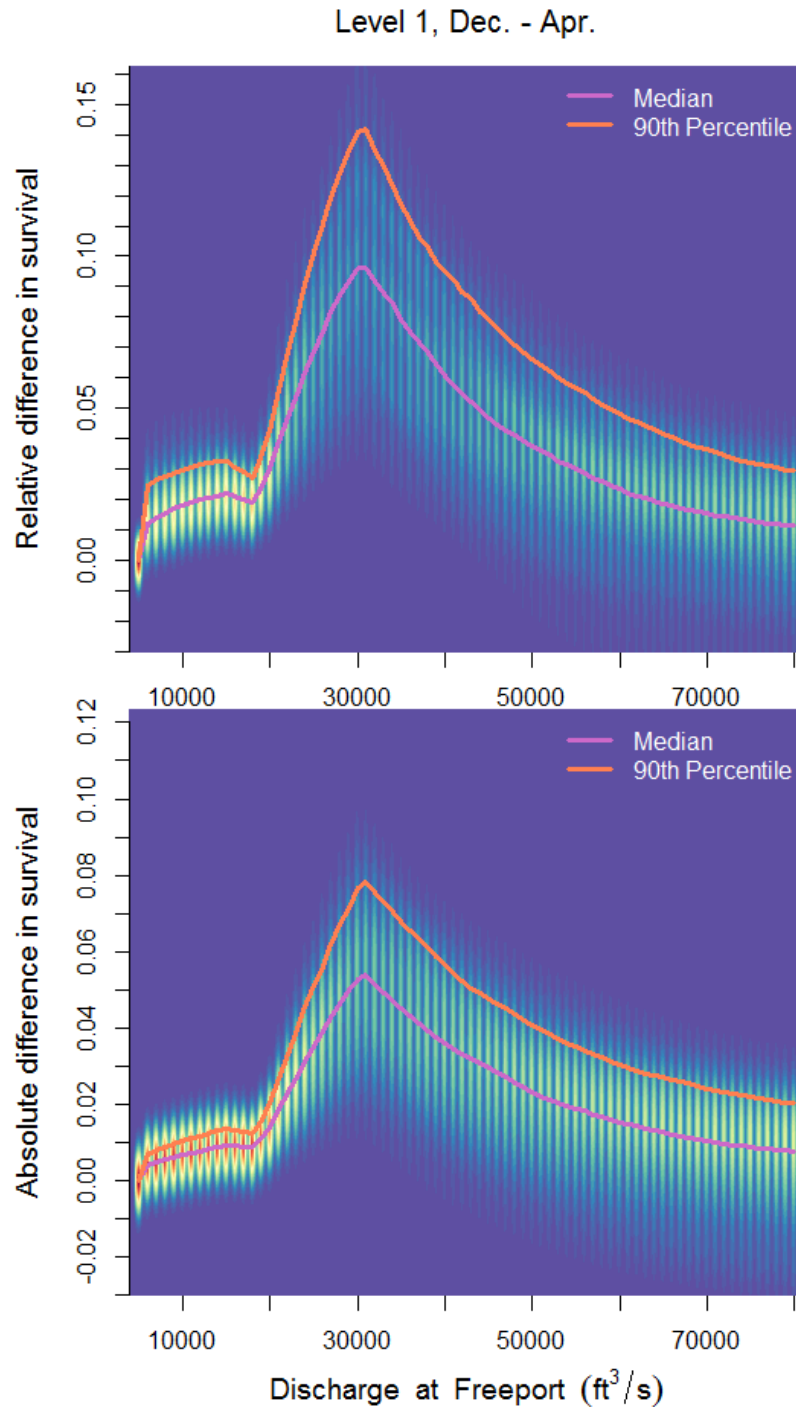


Figure 11.7. Posterior distributions for the relative (top graph) and absolute (bottom graph) difference in survival between no diversion and diversion at rates based on the Level 1, Dec.–April bypass rule. Each vertical color band is the posterior distribution of the survival differences that were calculated in increments of 1,000 ft³/s for the Sacramento River at Freeport. Darker colors (red) indicate regions of higher probability and lighter colors (yellow) indicate lower probability. The pink line marks the median difference in survival where there is a 50% probability of the survival difference being higher or lower. The orange line is the 90th percentile where 10% of survival differences are higher and 90% are lower.

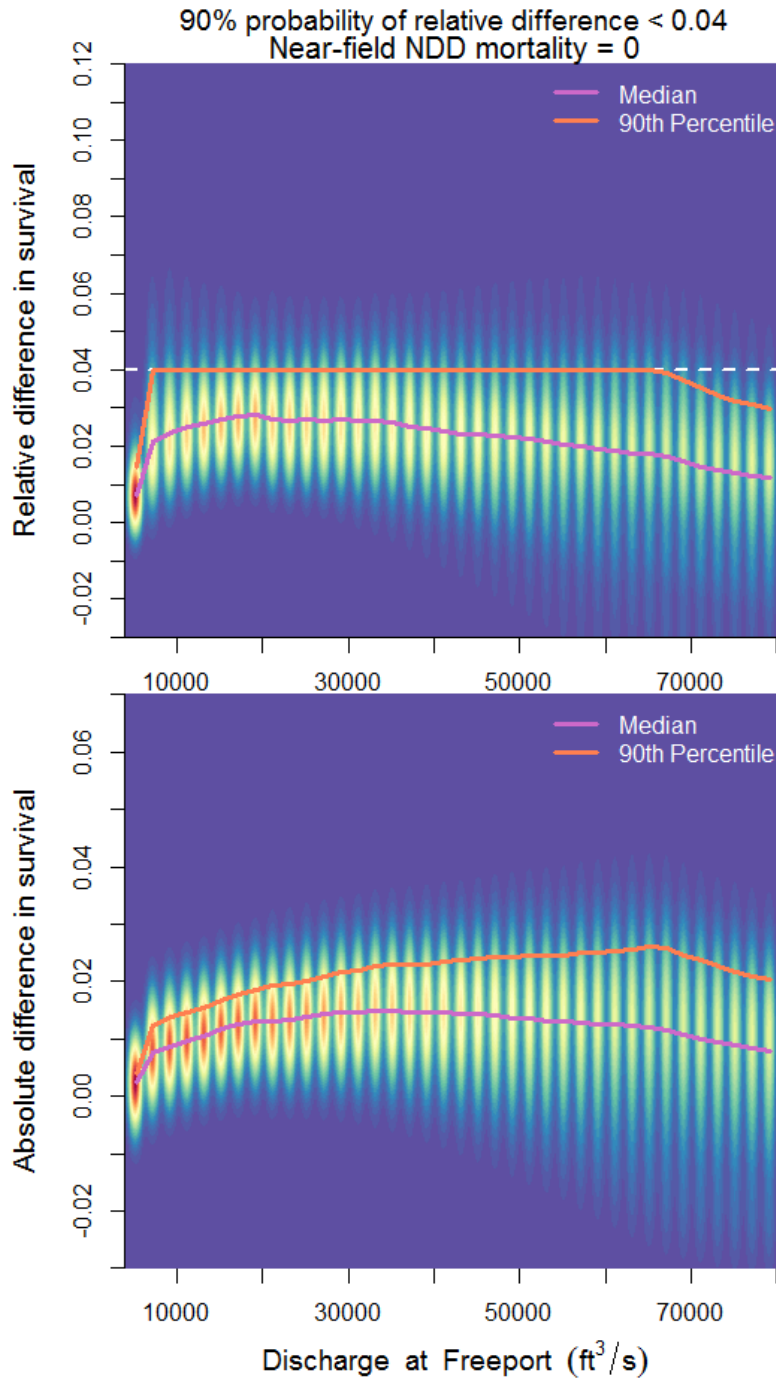


Figure 11.8. Posterior distributions for the relative (top graph) and absolute (bottom graph) difference in survival between no diversion and diversion at rates based on a criterion of a 90% probability of a relative difference in survival of 0.04 with zero near-field mortality. Each vertical color band is the posterior distribution of the survival differences that were calculated in increments of 2,000 ft^3/s for the Sacramento River at Freeport. Darker colors (red) indicate regions of higher probability and lighter colors (yellow) indicate lower probability. The pink line marks the median difference in survival where there is a 50% probability of the survival difference being higher or lower. The orange line is the 90th percentile where 10% of survival differences are higher and 90% are lower.

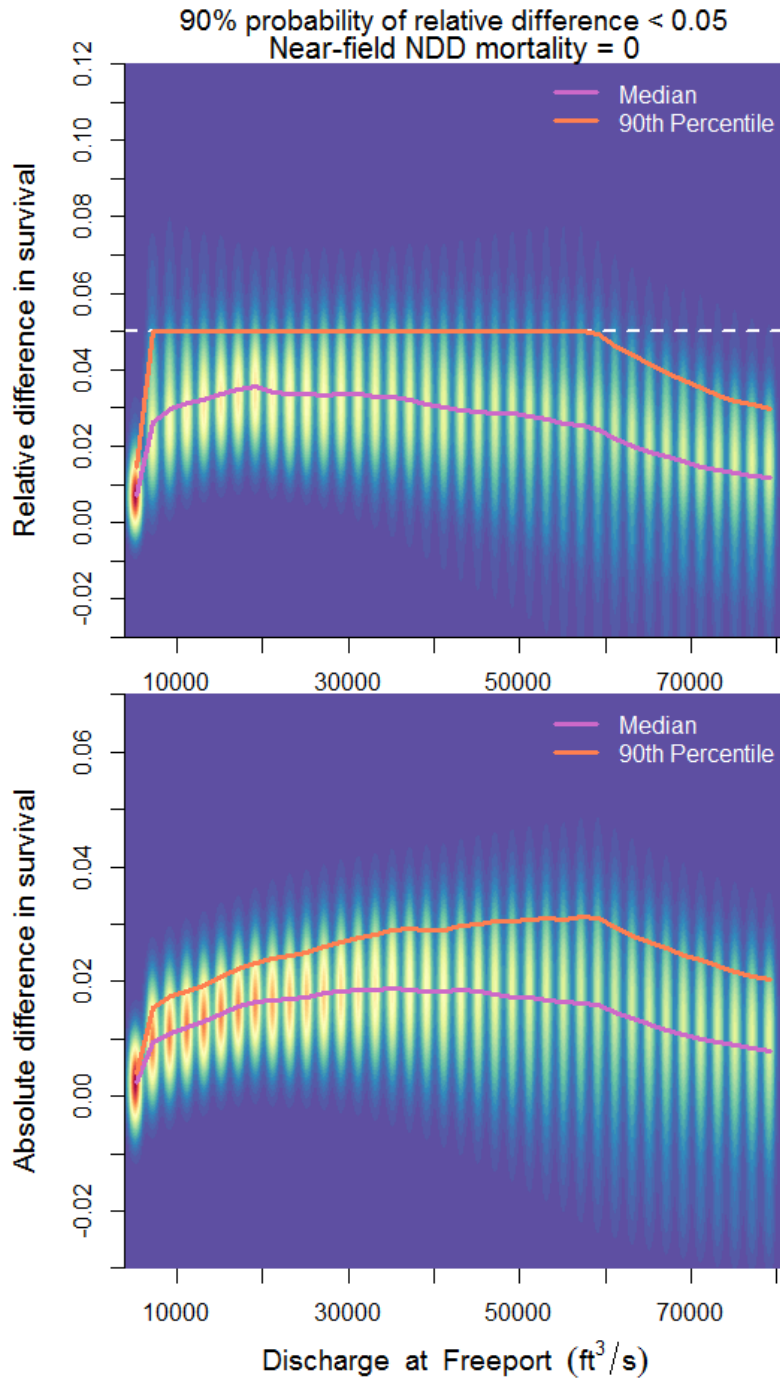


Figure 11.9. Posterior distributions for the relative (top graph) and absolute (bottom graph) difference in survival between no diversion and diversion at rates based on a criterion of a 90% probability of a relative difference in survival of 0.05 with zero near-field mortality. Each vertical color band is the posterior distribution of the survival differences that were calculated in increments of 2,000 ft^3/s for the Sacramento River at Freeport. Darker colors (red) indicate regions of higher probability and lighter colors (yellow) indicate lower probability. The pink line marks the median difference in survival where there is a 50% probability of the survival difference being higher or lower. The orange line is the 90th percentile where 10% of survival differences are higher and 90% are lower.

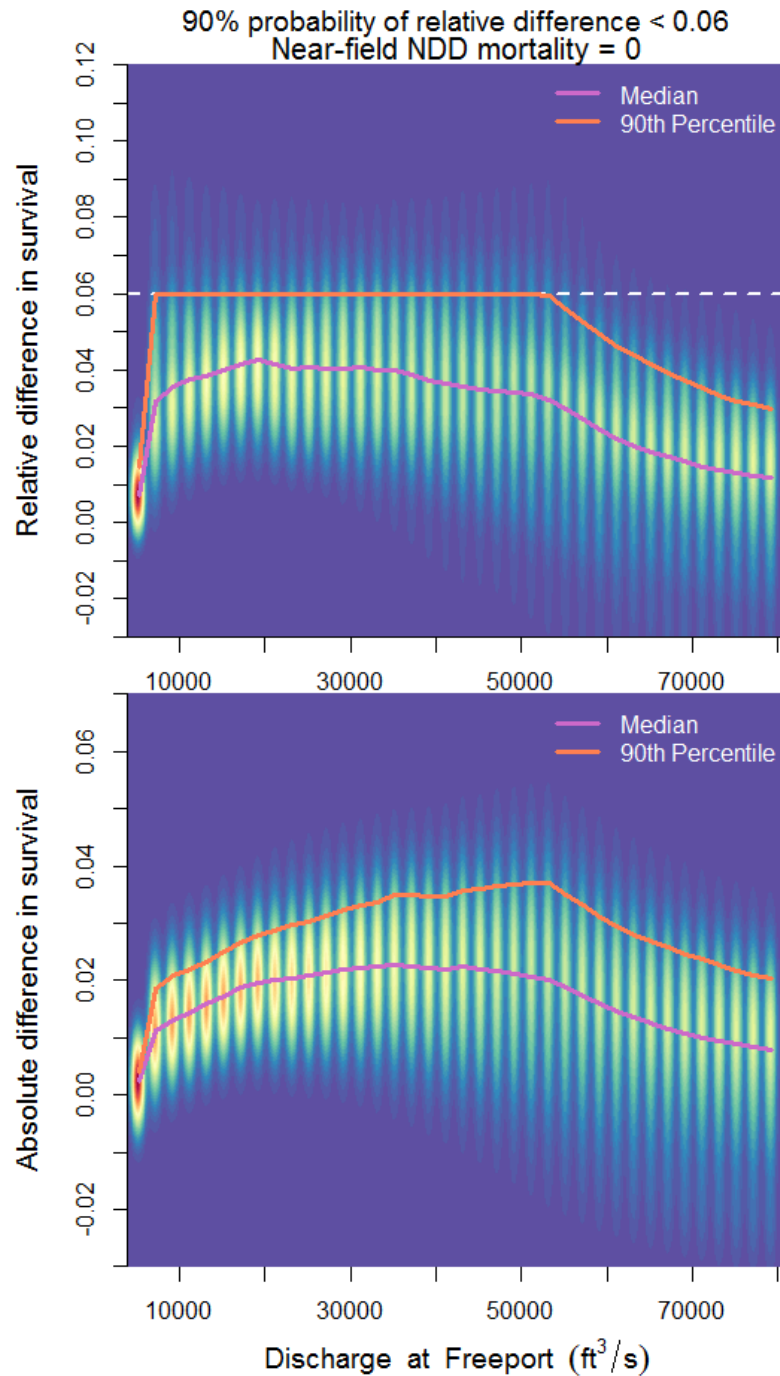


Figure 11.10. Posterior distributions for the relative (top graph) and absolute (bottom graph) difference in survival between no diversion and diversion at rates based on a criterion of a 90% probability of a relative difference in survival of 0.06 with zero near-field mortality. Each vertical color band is the posterior distribution of the survival differences that were calculated in increments of 2,000 ft^3/s for the Sacramento River at Freeport. Darker colors (red) indicate regions of higher probability and lighter colors (yellow) indicate lower probability. The pink line marks the median difference in survival where there is a 50% probability of the survival difference being higher or lower. The orange line is the 90th percentile where 10% of survival differences are higher and 90% are lower.

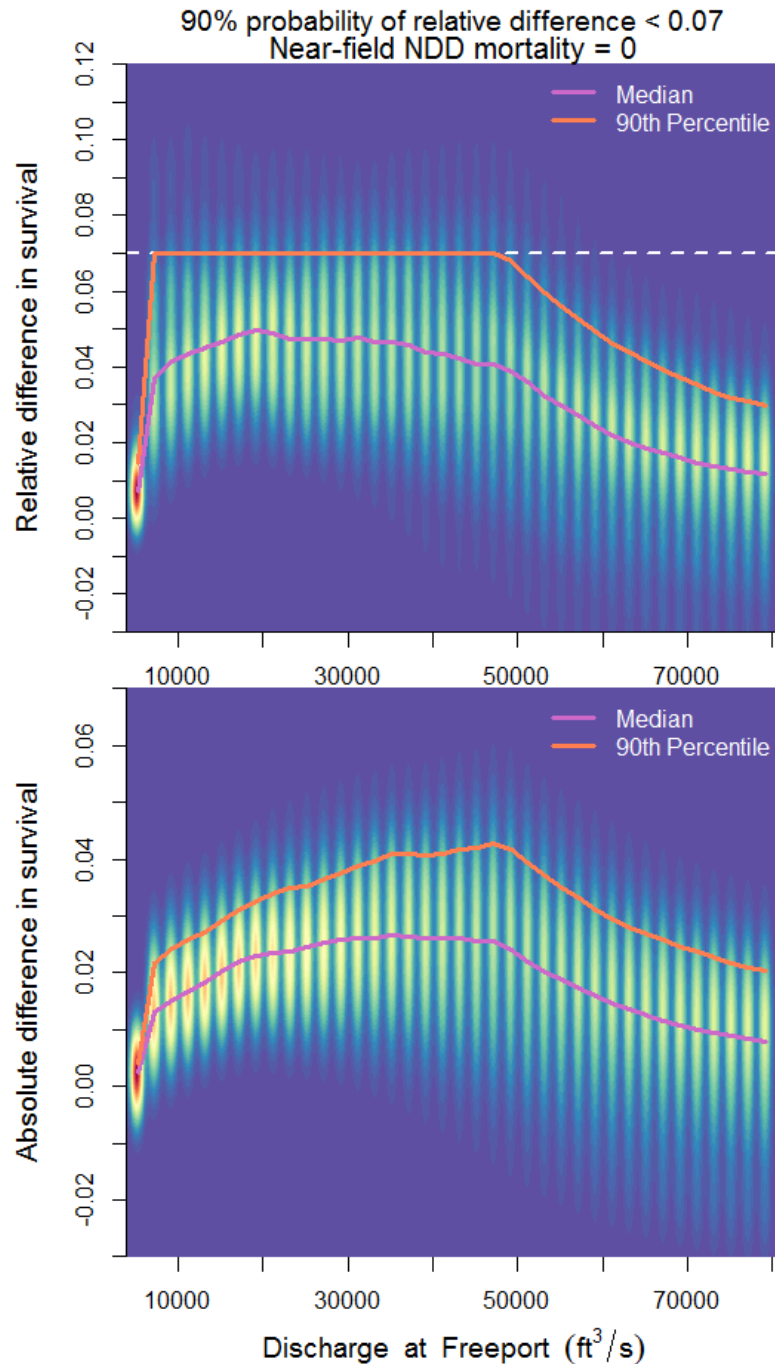


Figure 11.11. Posterior distributions for the relative (top graph) and absolute (bottom graph) difference in survival between no diversion and diversion at rates based on a criterion of a 90% probability of a relative difference in survival of 0.07 with zero near-field mortality. Each vertical color band is the posterior distribution of the survival differences that were calculated in increments of 2,000 ft^3/s for the Sacramento River at Freeport. Darker colors (red) indicate regions of higher probability and lighter colors (yellow) indicate lower probability. The pink line marks the median difference in survival where there is a 50% probability of the survival difference being higher or lower. The orange line is the 90th percentile where 10% of survival differences are higher and 90% are lower.

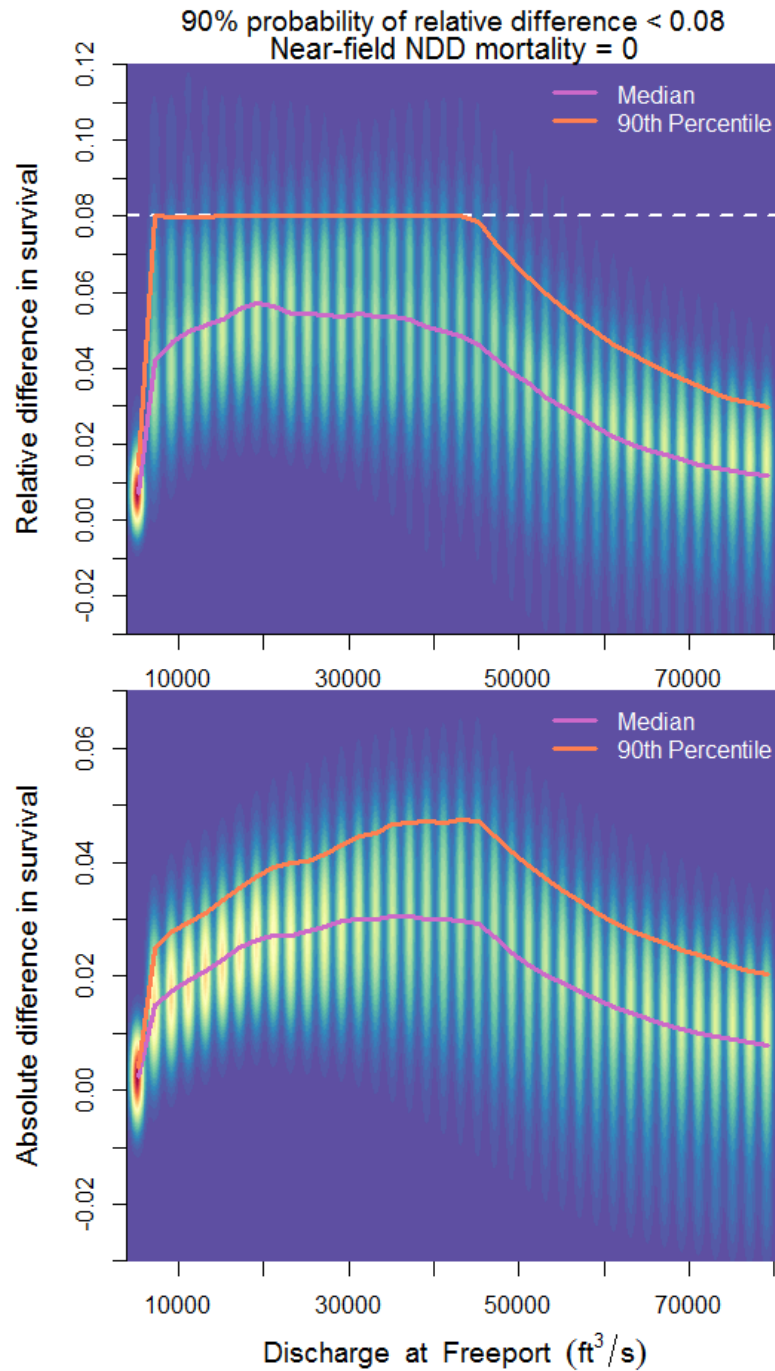


Figure 11.12. Posterior distributions for the relative (top graph) and absolute (bottom graph) difference in survival between no diversion and diversion at rates based on a criterion of a 90% probability of a relative difference in survival of 0.08 with zero near-field mortality. Each vertical color band is the posterior distribution of the survival differences that were calculated in increments of 2,000 ft^3/s for the Sacramento River at Freeport. Darker colors (red) indicate regions of higher probability and lighter colors (yellow) indicate lower probability. The pink line marks the median difference in survival where there is a 50% probability of the survival difference being higher or lower. The orange line is the 90th percentile where 10% of survival differences are higher and 90% are lower.

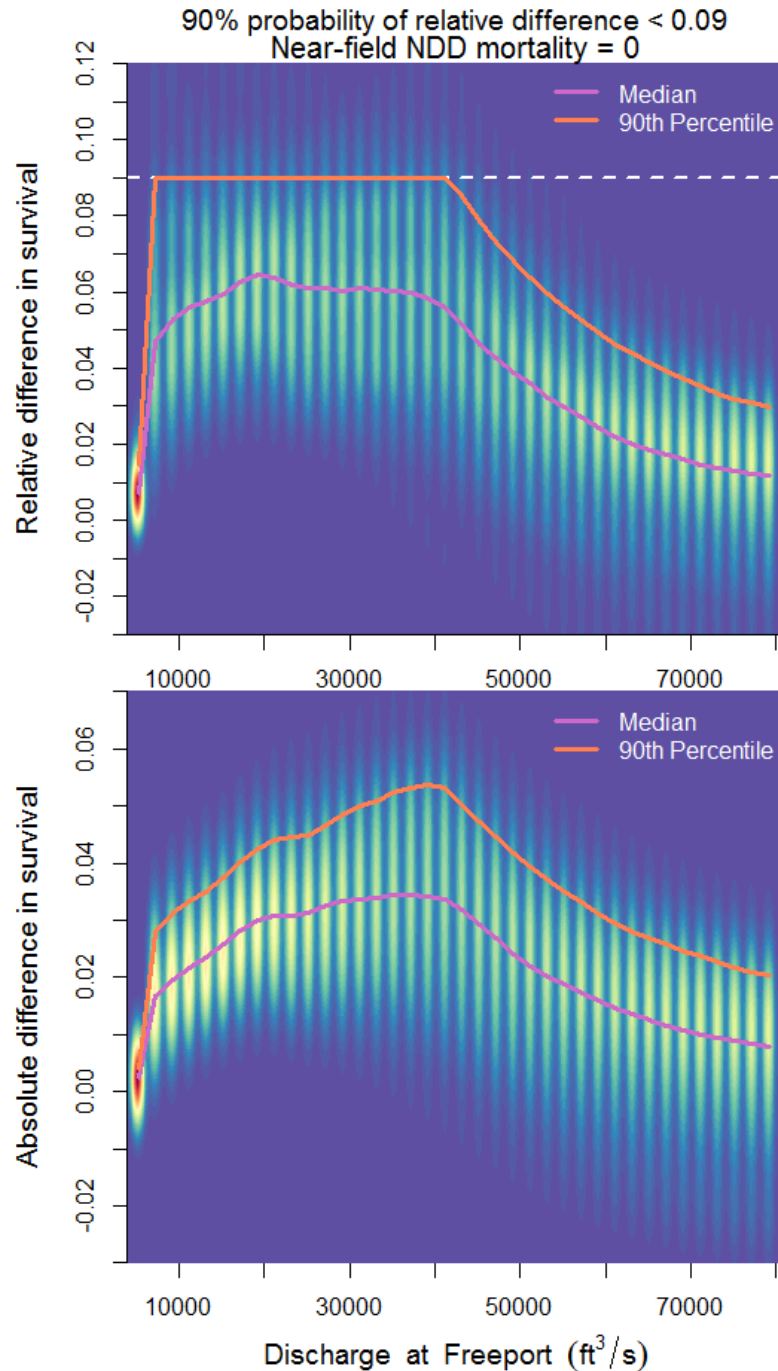


Figure 11.13. Posterior distributions for the relative (top graph) and absolute (bottom graph) difference in survival between no diversion and diversion at rates based on a criterion of a 90% probability of a relative difference in survival of 0.09 with zero near-field mortality. Each vertical color band is the posterior distribution of the survival differences that were calculated in increments of 2,000 ft^3/s for the Sacramento River at Freeport. Darker colors (red) indicate regions of higher probability and lighter colors (yellow) indicate lower probability. The pink line marks the median difference in survival where there is a 50% probability of the survival difference being higher or lower. The orange line is the 90th percentile where 10% of survival differences are higher and 90% are lower.

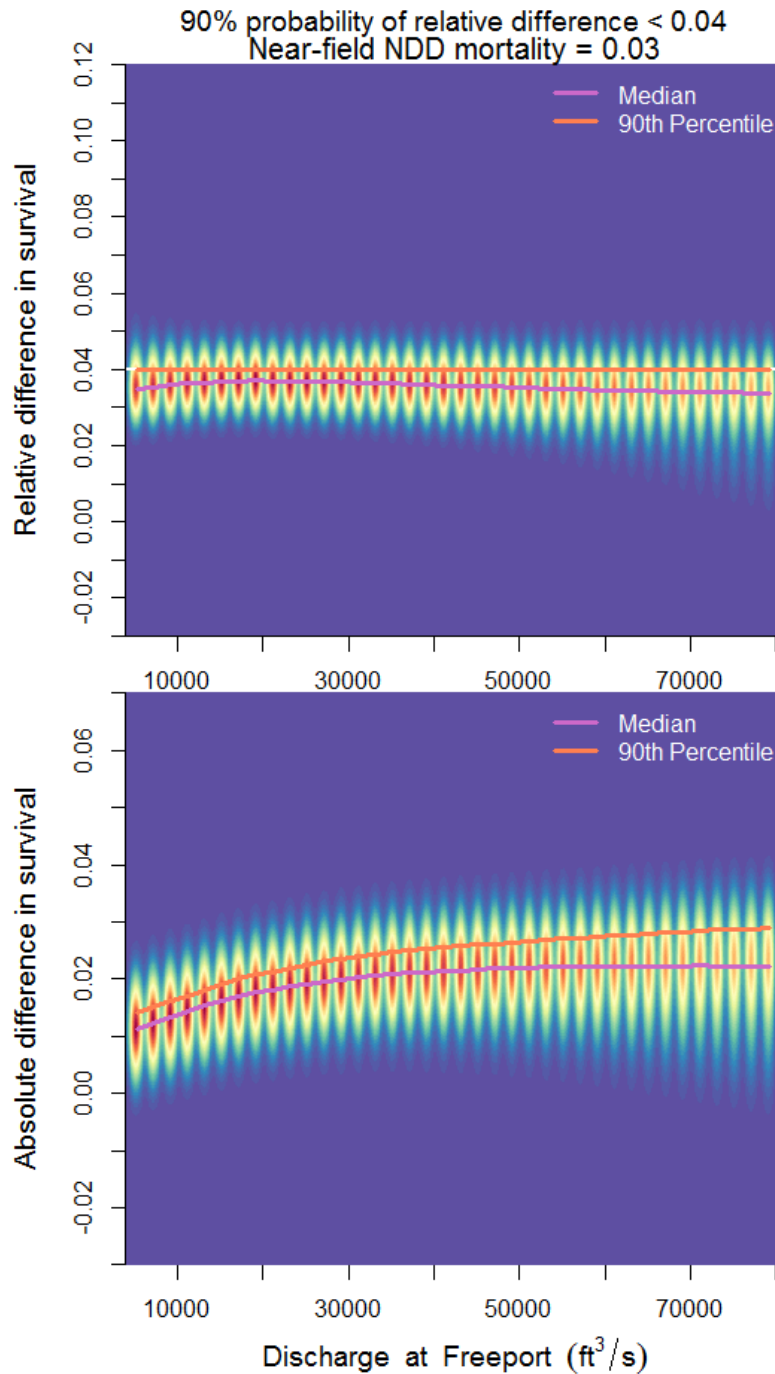


Figure 11.14. Posterior distributions for the relative (top graph) and absolute (bottom graph) difference in survival between no diversion and diversion at rates based on a criterion of a 90% probability of a relative difference in survival of 0.04 with near-field mortality of 0.03. Each vertical color band is the posterior distribution of the survival differences that were calculated in increments of 2,000 ft^3/s for the Sacramento River at Freeport. Darker colors (red) indicate regions of higher probability and lighter colors (yellow) indicate lower probability. The pink line marks the median difference in survival where there is a 50% probability of the survival difference being higher or lower. The orange line is the 90th percentile where 10% of survival differences are higher and 90% are lower.

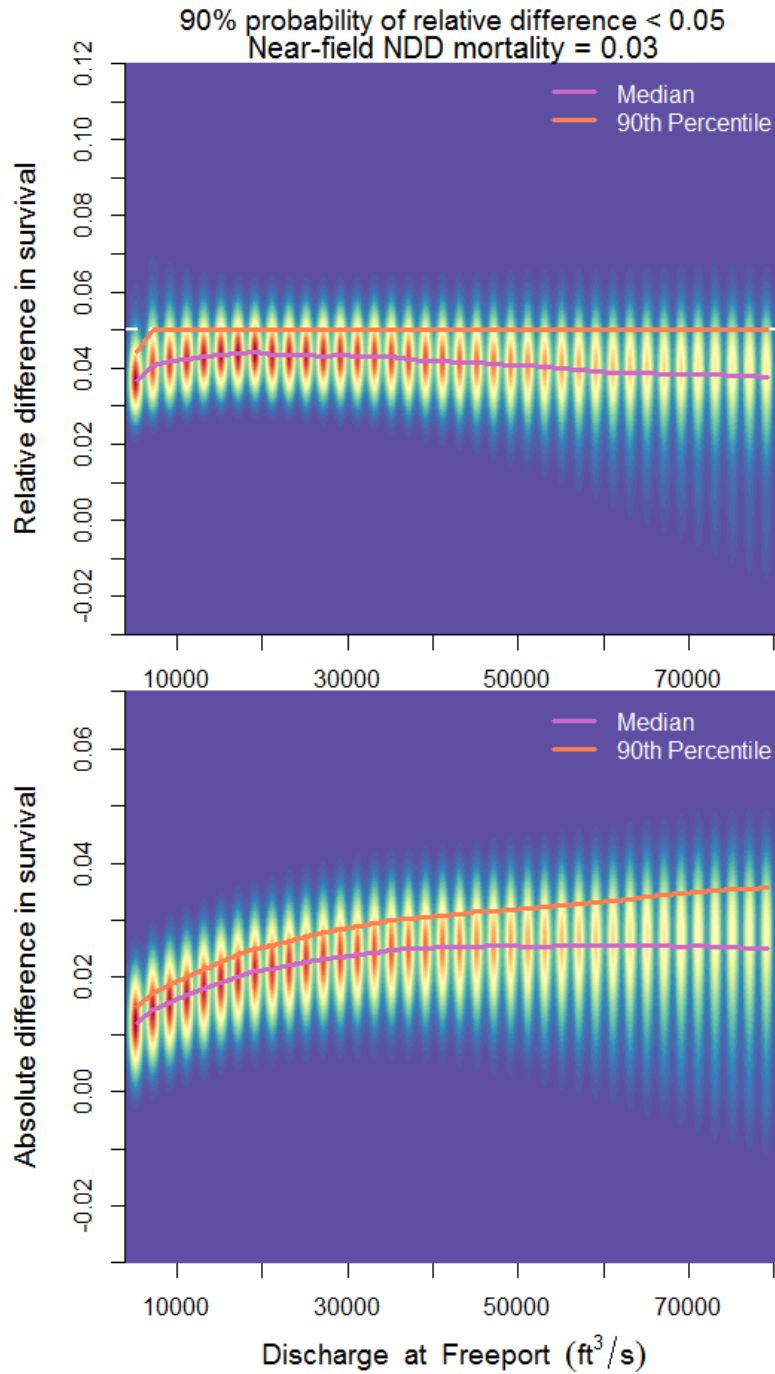


Figure 11.15. Posterior distributions for the relative (top graph) and absolute (bottom graph) difference in survival between no diversion and diversion at rates based on a criterion of a 90% probability of a relative difference in survival of 0.05 with near-field mortality of 0.03. Each vertical color band is the posterior distribution of the survival differences that were calculated in increments of 2,000 ft^3/s for the Sacramento River at Freeport. Darker colors (red) indicate regions of higher probability and lighter colors (yellow) indicate lower probability. The pink line marks the median difference in survival where there is a 50% probability of the survival difference being higher or lower. The orange line is the 90th percentile where 10% of survival differences are higher and 90% are lower.

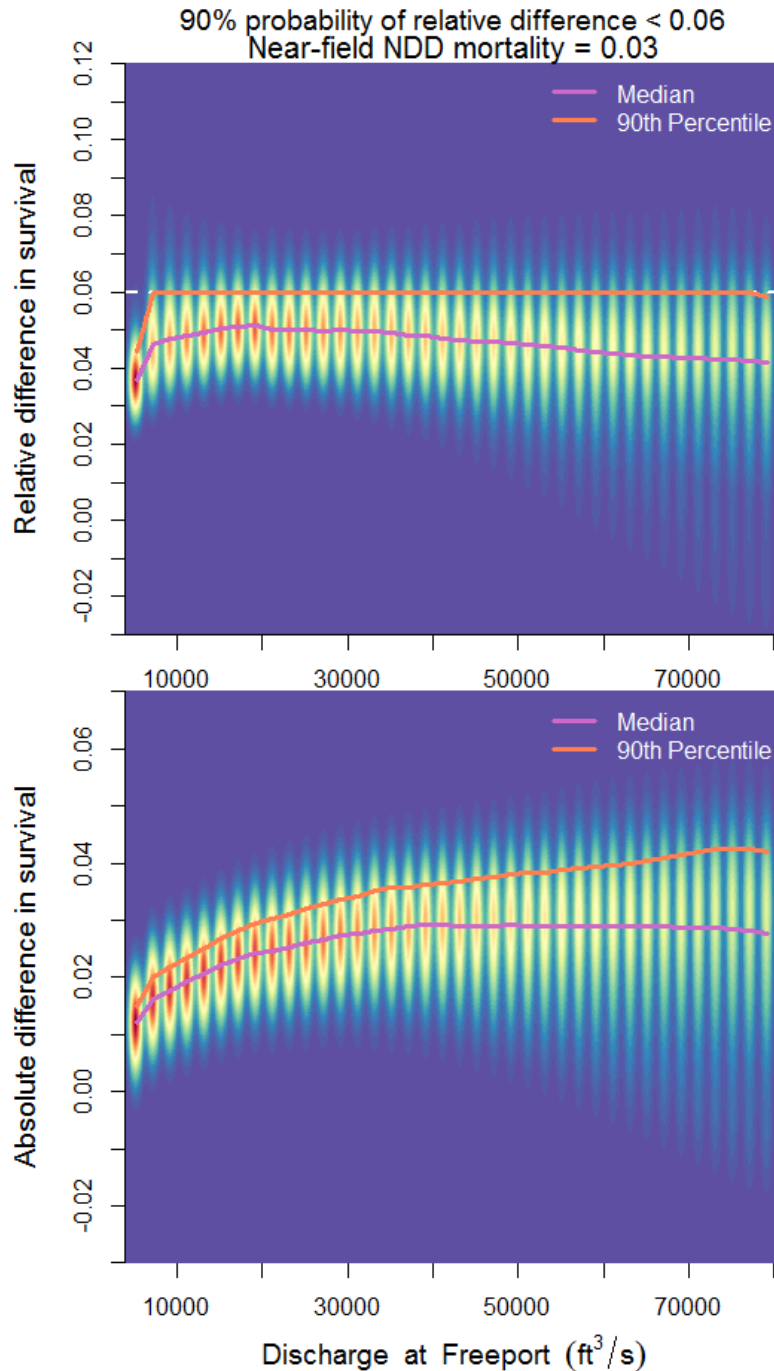


Figure 11.16. Posterior distributions for the relative (top graph) and absolute (bottom graph) difference in survival between no diversion and diversion at rates based on a criterion of a 90% probability of a relative difference in survival of 0.06 with near-field mortality of 0.03. Each vertical color band is the posterior distribution of the survival differences that were calculated in increments of 2,000 ft³/s for the Sacramento River at Freeport. Darker colors (red) indicate regions of higher probability and lighter colors (yellow) indicate lower probability. The pink line marks the median difference in survival where there is a 50% probability of the survival difference being higher or lower. The orange line is the 90th percentile where 10% of survival differences are higher and 90% are lower.

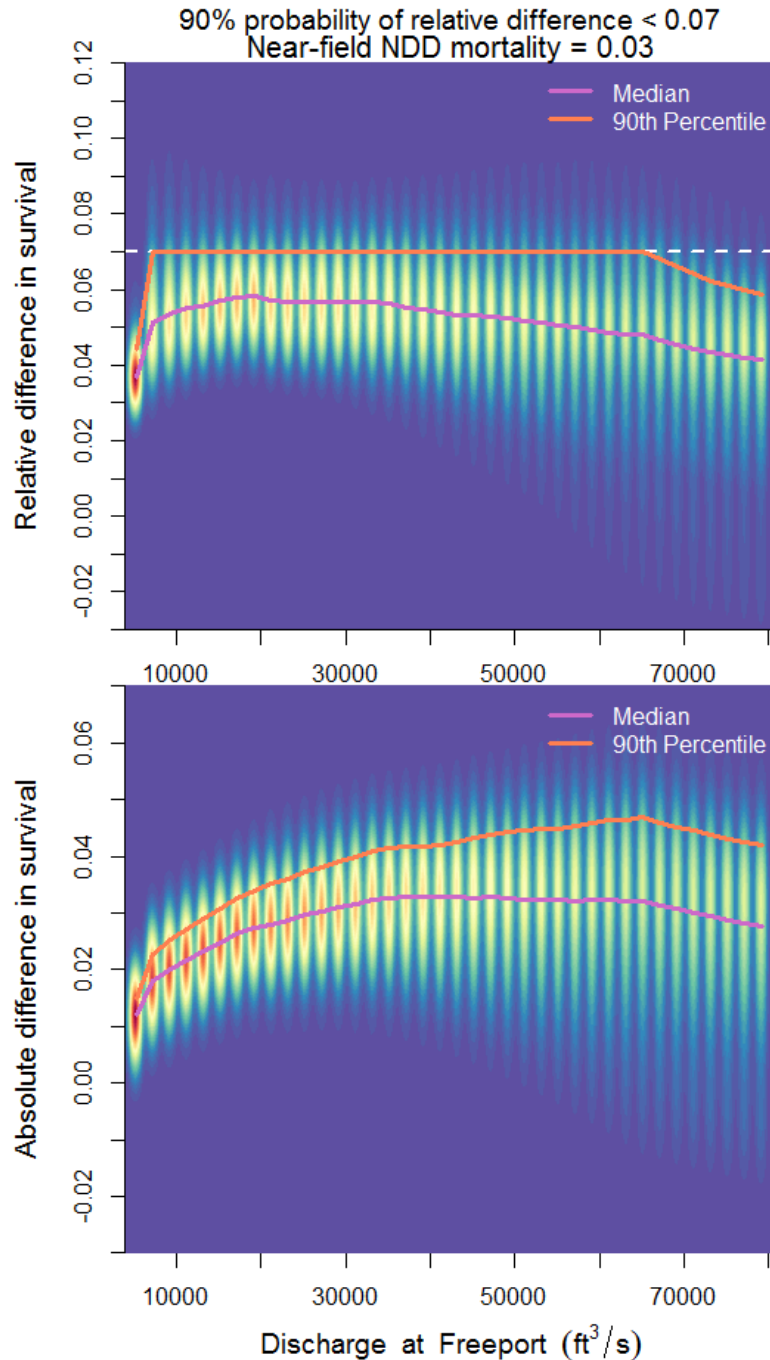


Figure 11.17. Posterior distributions for the relative (top graph) and absolute (bottom graph) difference in survival between no diversion and diversion at rates based on a criterion of a 90% probability of a relative difference in survival of 0.05 with near-field mortality of 0.07. Each vertical color band is the posterior distribution of the survival differences that were calculated in increments of 2,000 ft^3/s for the Sacramento River at Freeport. Darker colors (red) indicate regions of higher probability and lighter colors (yellow) indicate lower probability. The pink line marks the median difference in survival where there is a 50% probability of the survival difference being higher or lower. The orange line is the 90th percentile where 10% of survival differences are higher and 90% are lower.

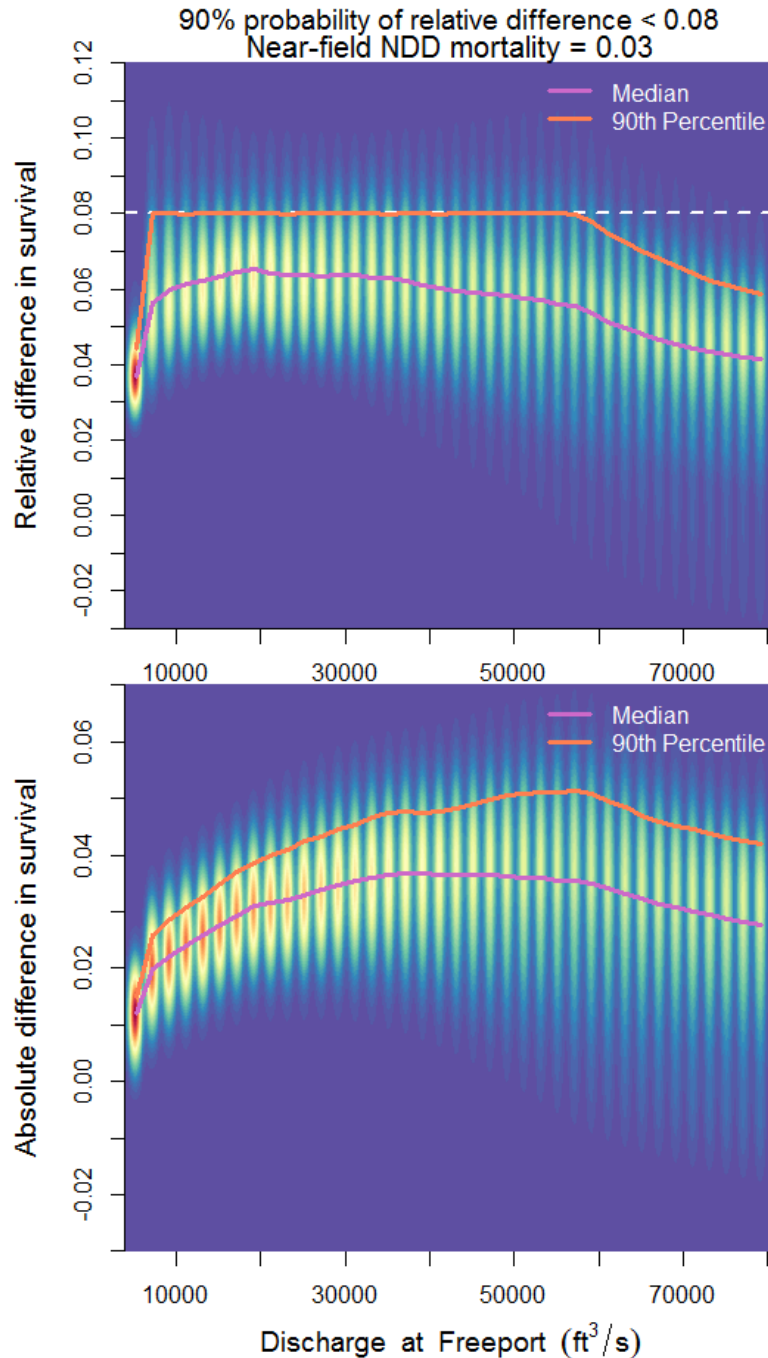


Figure 11.18. Posterior distributions for the relative (top graph) and absolute (bottom graph) difference in survival between no diversion and diversion at rates based on a criterion of a 90% probability of a relative difference in survival of 0.08 with near-field mortality of 0.03. Each vertical color band is the posterior distribution of the survival differences that were calculated in increments of 2,000 ft^3/s for the Sacramento River at Freeport. Darker colors (red) indicate regions of higher probability and lighter colors (yellow) indicate lower probability. The pink line marks the median difference in survival where there is a 50% probability of the survival difference being higher or lower. The orange line is the 90th percentile where 10% of survival differences are higher and 90% are lower.

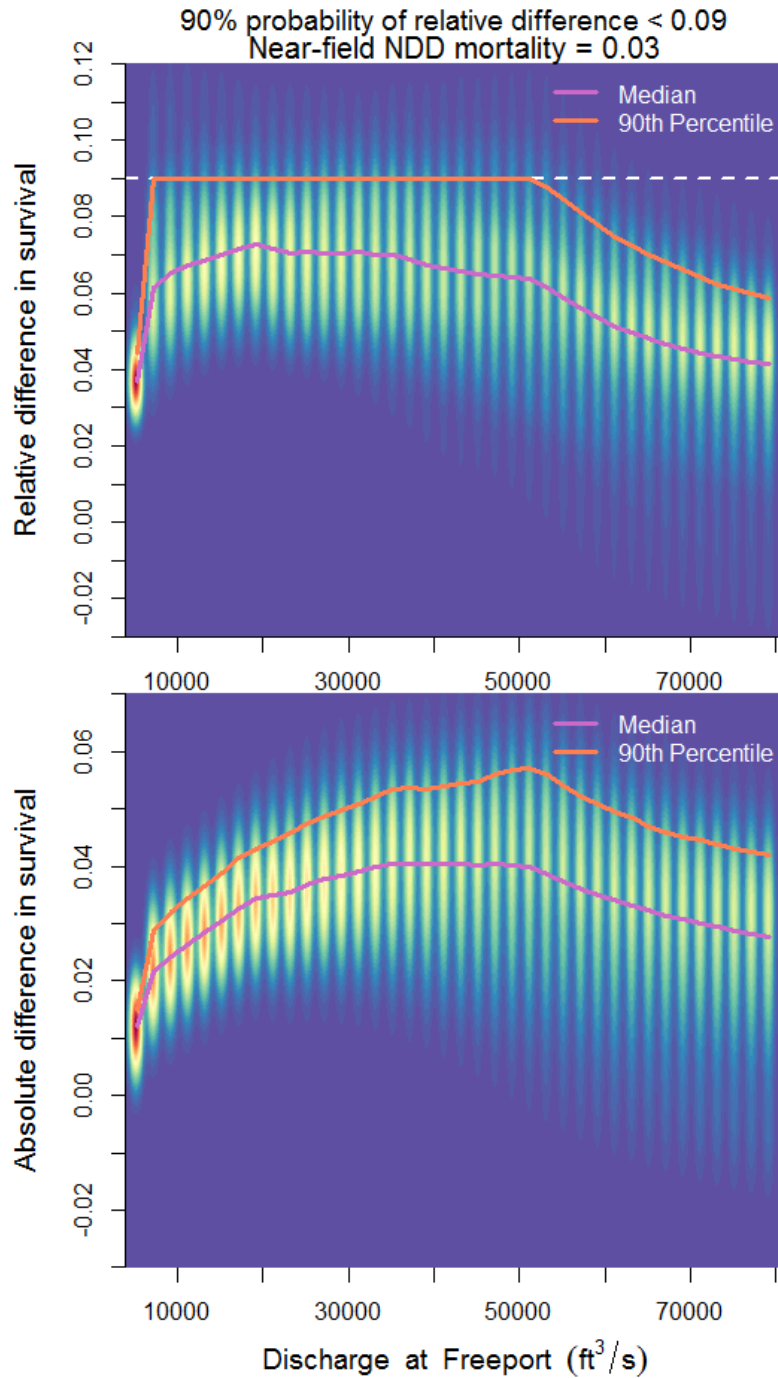


Figure 11.19. Posterior distributions for the relative (top graph) and absolute (bottom graph) difference in survival between no diversion and diversion at rates based on a criterion of a 90% probability of a relative difference in survival of 0.09 with near-field mortality of 0.03. Each vertical color band is the posterior distribution of the survival differences that were calculated in increments of 2,000 ft^3/s for the Sacramento River at Freeport. Darker colors (red) indicate regions of higher probability and lighter colors (yellow) indicate lower probability. The pink line marks the median difference in survival where there is a 50% probability of the survival difference being higher or lower. The orange line is the 90th percentile where 10% of survival differences are higher and 90% are lower.

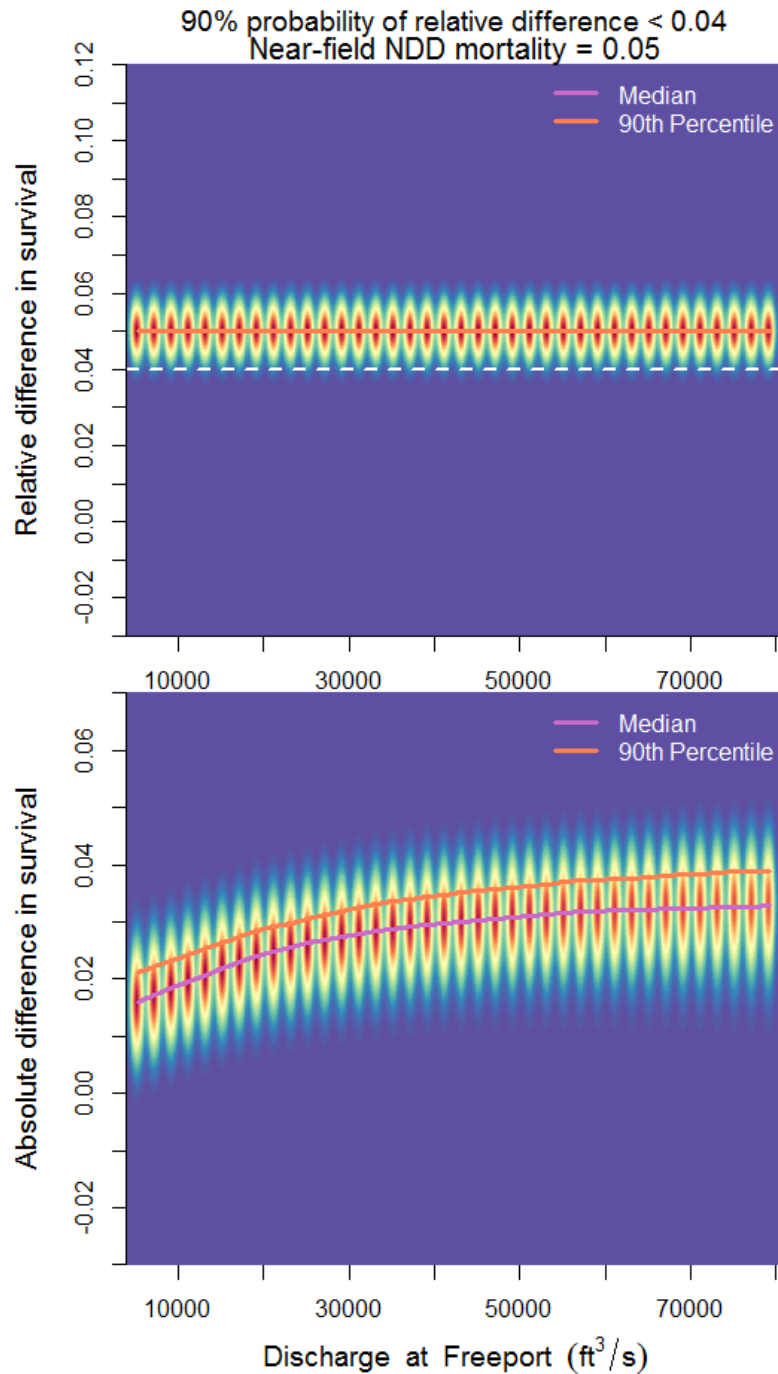


Figure 11.20. Posterior distributions for the relative (top graph) and absolute (bottom graph) difference in survival between no diversion and diversion at rates based on a criterion of a 90% probability of a relative difference in survival of 0.04 with near-field mortality of 0.05. Each vertical color band is the posterior distribution of the survival differences that were calculated in increments of 2,000 ft^3/s for the Sacramento River at Freeport. Darker colors (red) indicate regions of higher probability and lighter colors (yellow) indicate lower probability. The pink line marks the median difference in survival where there is a 50% probability of the survival difference being higher or lower. The orange line is the 90th percentile where 10% of survival differences are higher and 90% are lower.

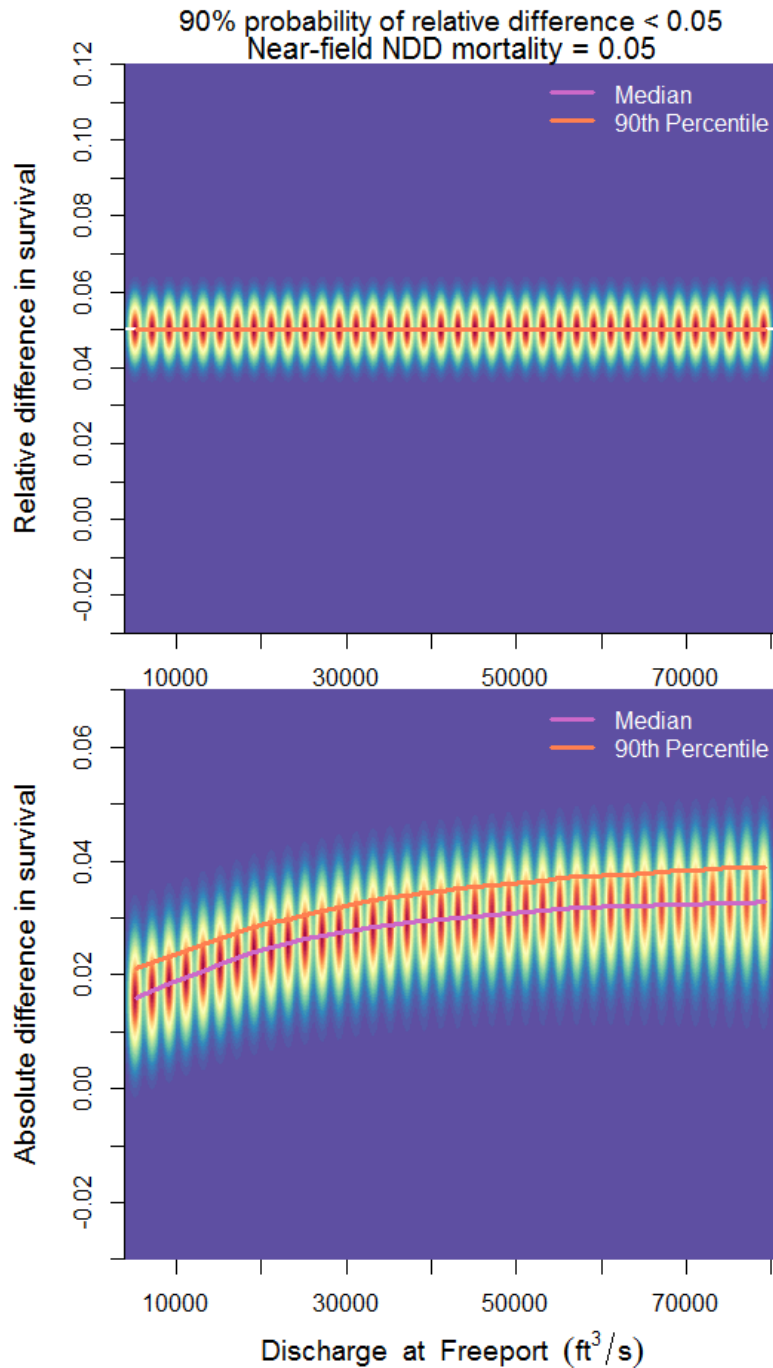


Figure 11.21. Posterior distributions for the relative (top graph) and absolute (bottom graph) difference in survival between no diversion and diversion at rates based on a criterion of a 90% probability of a relative difference in survival of 0.05 with near-field mortality of 0.05. Each vertical color band is the posterior distribution of the survival differences that were calculated in increments of 2,000 ft^3/s for the Sacramento River at Freeport. Darker colors (red) indicate regions of higher probability and lighter colors (yellow) indicate lower probability. The pink line marks the median difference in survival where there is a 50% probability of the survival difference being higher or lower. The orange line is the 90th percentile where 10% of survival differences are higher and 90% are lower.

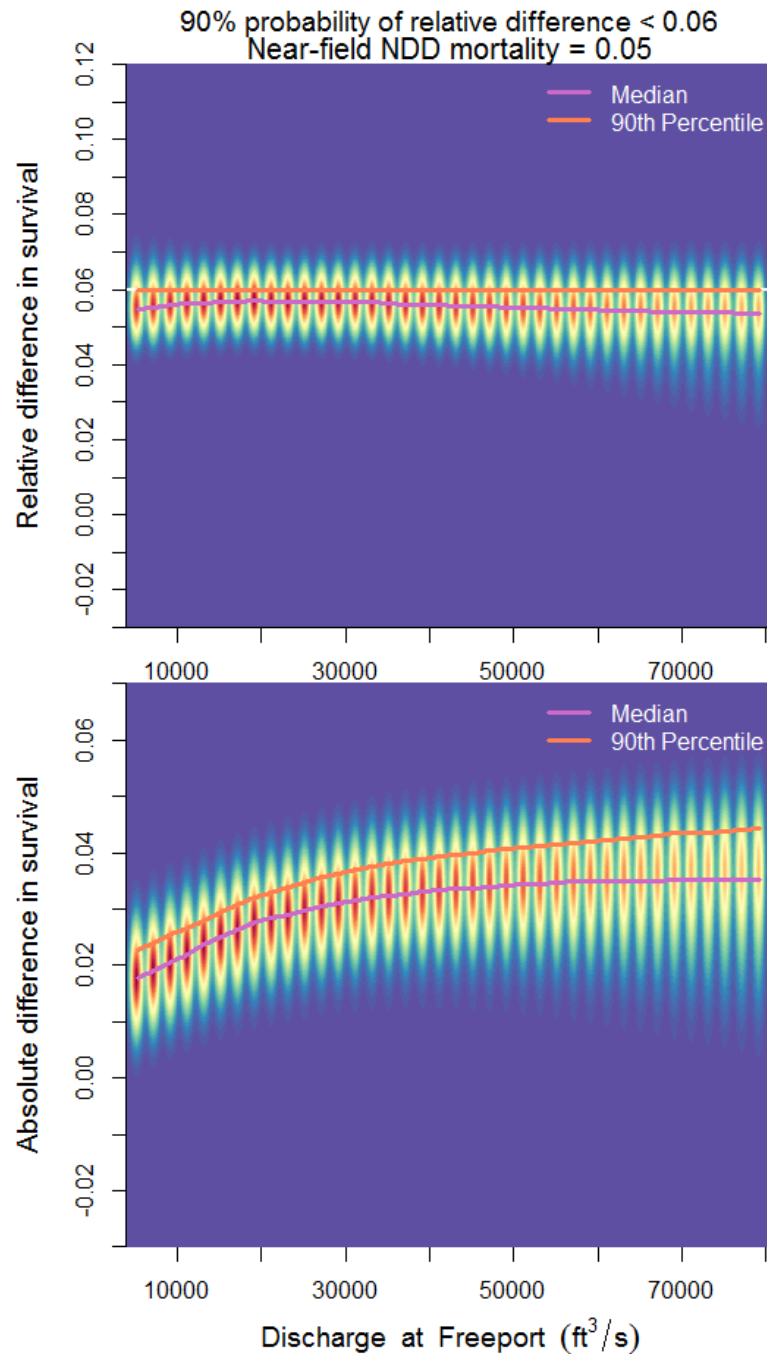


Figure 11.22. Posterior distributions for the relative (top graph) and absolute (bottom graph) difference in survival between no diversion and diversion at rates based on a criterion of a 90% probability of a relative difference in survival of 0.06 with near-field mortality of 0.05. Each vertical color band is the posterior distribution of the survival differences that were calculated in increments of 2,000 ft^3/s for the Sacramento River at Freeport. Darker colors (red) indicate regions of higher probability and lighter colors (yellow) indicate lower probability. The pink line marks the median difference in survival where there is a 50% probability of the survival difference being higher or lower. The orange line is the 90th percentile where 10% of survival differences are higher and 90% are lower.

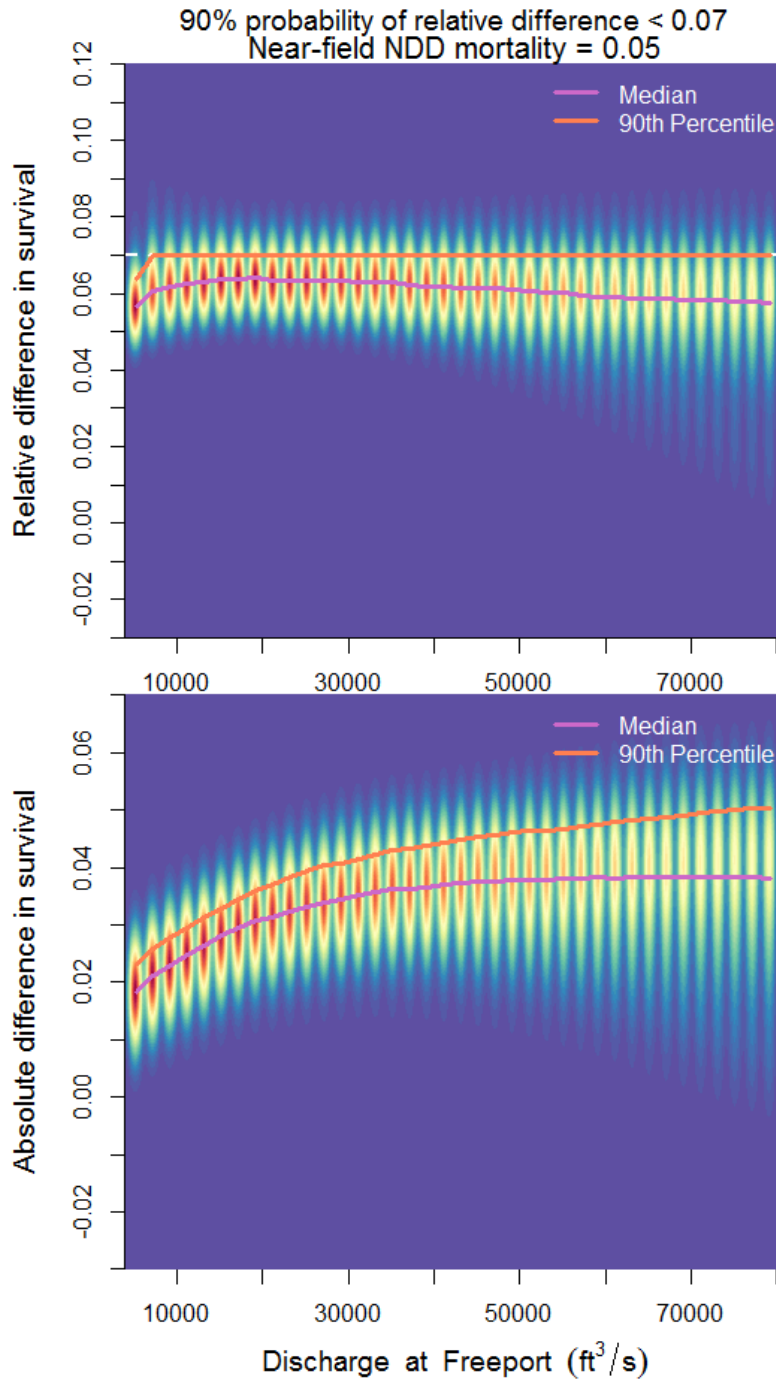


Figure 11.23. Posterior distributions for the relative (top graph) and absolute (bottom graph) difference in survival between no diversion and diversion at rates based on a criterion of a 90% probability of a relative difference in survival of 0.07 with near-field mortality of 0.05. Each vertical color band is the posterior distribution of the survival differences that were calculated in increments of 2,000 ft^3/s for the Sacramento River at Freeport. Darker colors (red) indicate regions of higher probability and lighter colors (yellow) indicate lower probability. The pink line marks the median difference in survival where there is a 50% probability of the survival difference being higher or lower. The orange line is the 90th percentile where 10% of survival differences are higher and 90% are lower.

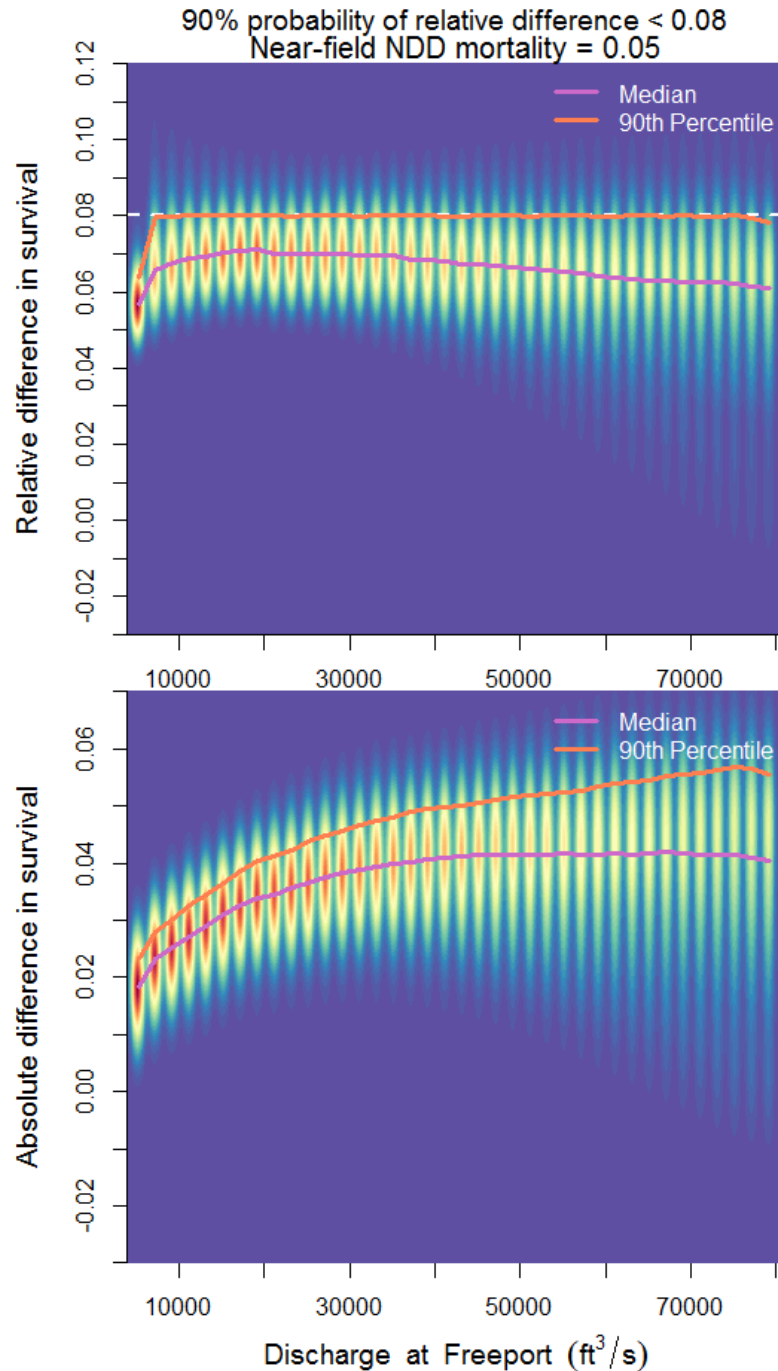


Figure 11.24. Posterior distributions for the relative (top graph) and absolute (bottom graph) difference in survival between no diversion and diversion at rates based on a criterion of a 90% probability of a relative difference in survival of 0.08 with near-field mortality of 0.05. Each vertical color band is the posterior distribution of the survival differences that were calculated in increments of 2,000 ft^3/s for the Sacramento River at Freeport. Darker colors (red) indicate regions of higher probability and lighter colors (yellow) indicate lower probability. The pink line marks the median difference in survival where there is a 50% probability of the survival difference being higher or lower. The orange line is the 90th percentile where 10% of survival differences are higher and 90% are lower.

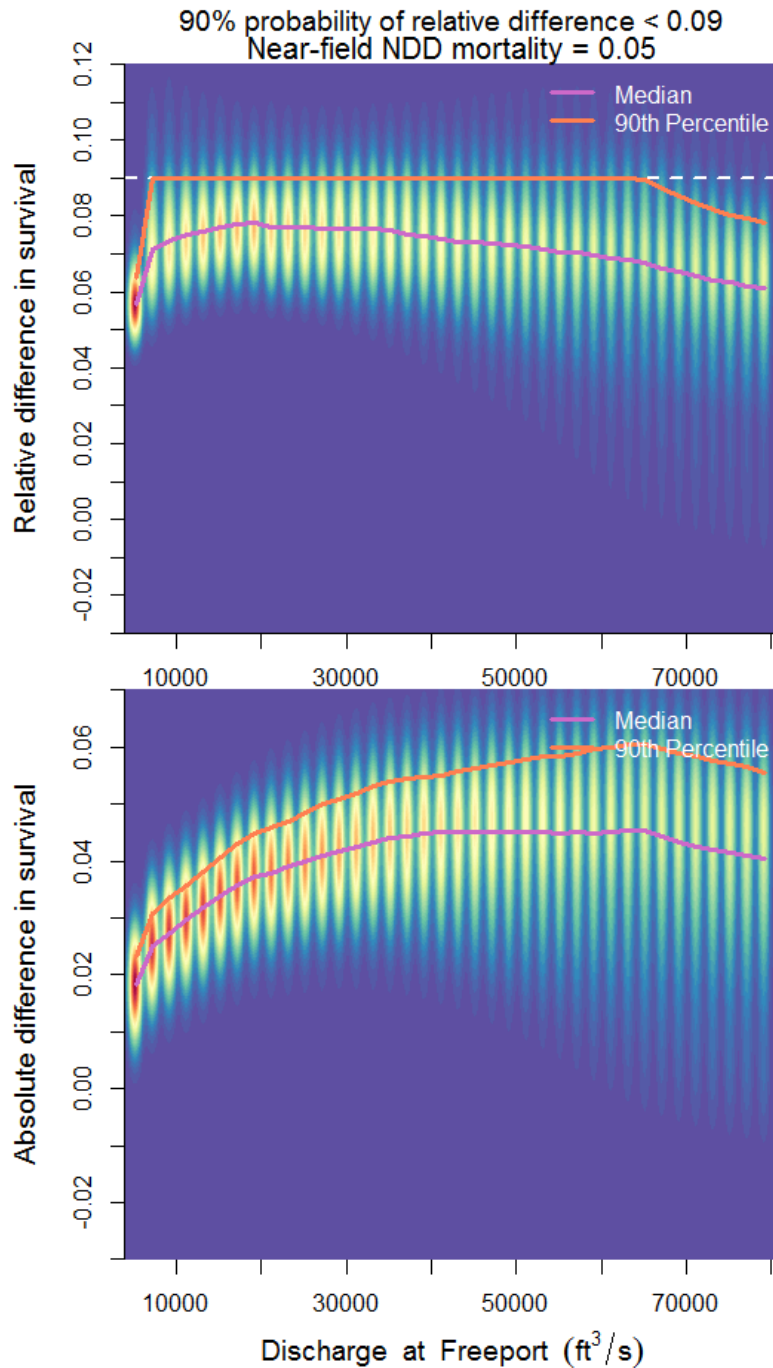


Figure 11.25. Posterior distributions for the relative (top graph) and absolute (bottom graph) difference in survival between no diversion and diversion at rates based on a criterion of a 90% probability of a relative difference in survival of 0.09 with near-field mortality of 0.05. Each vertical color band is the posterior distribution of the survival differences that were calculated in increments of 2,000 ft^3/s for the Sacramento River at Freeport. Darker colors (red) indicate regions of higher probability and lighter colors (yellow) indicate lower probability. The pink line marks the median difference in survival where there is a 50% probability of the survival difference being higher or lower. The orange line is the 90th percentile where 10% of survival differences are higher and 90% are lower.

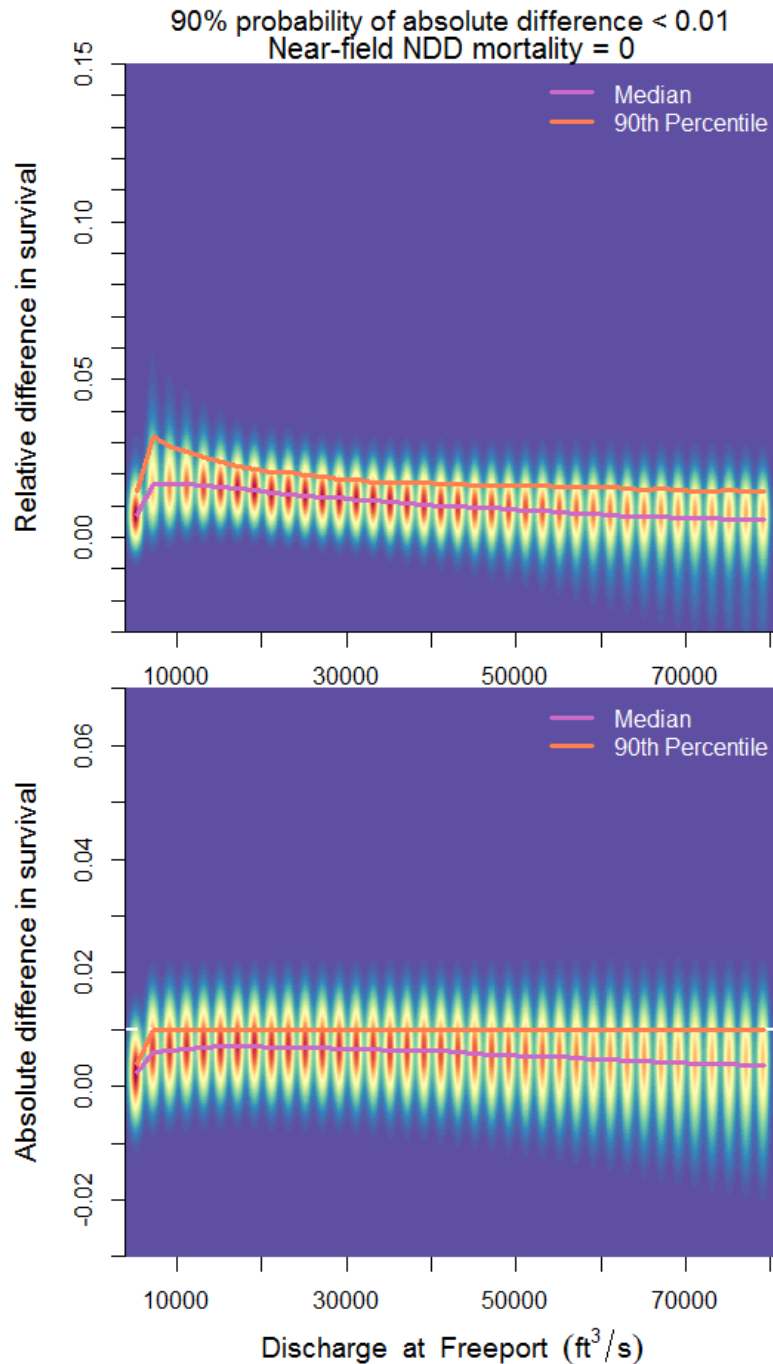


Figure 11.26. Posterior distributions for the relative (top graph) and absolute (bottom graph) difference in survival between no diversion and diversion at rates based on a criterion of a 90% probability of an absolute difference in survival of 0.01 with zero near-field mortality. Each vertical color band is the posterior distribution of the survival differences that were calculated in increments of 2,000 ft^3/s for the Sacramento River at Freeport. Darker colors (red) indicate regions of higher probability and lighter colors (yellow) indicate lower probability. The pink line marks the median difference in survival where there is a 50% probability of the survival difference being higher or lower. The orange line is the 90th percentile where 10% of survival differences are higher and 90% are lower.

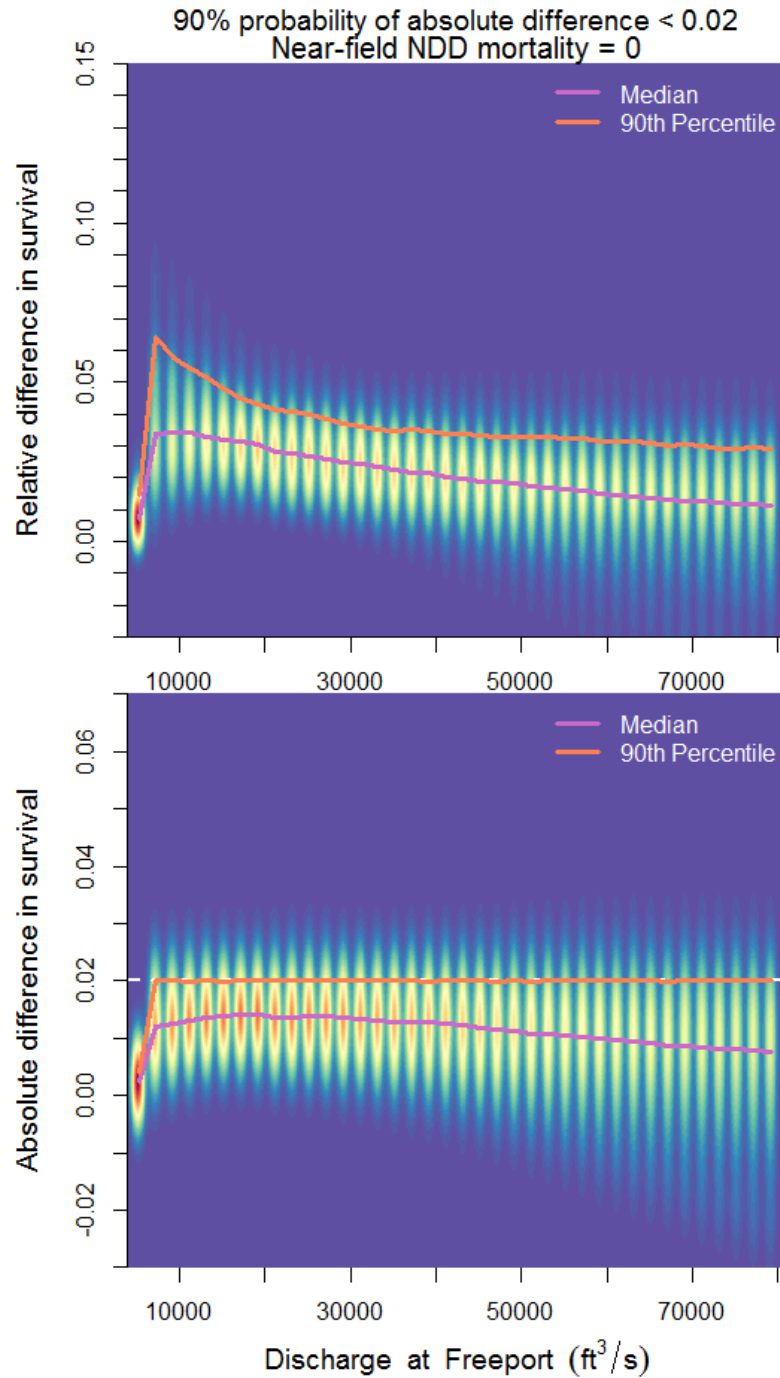


Figure 11.27. Posterior distributions for the relative (top graph) and absolute (bottom graph) difference in survival between no diversion and diversion at rates based on a criterion of a 90% probability of an absolute difference in survival of 0.02 with zero near-field mortality. Each vertical color band is the posterior distribution of the survival differences that were calculated in increments of 2,000 ft^3/s for the Sacramento River at Freeport. Darker colors (red) indicate regions of higher probability and lighter colors (yellow) indicate lower probability. The pink line marks the median difference in survival where there is a 50% probability of the survival difference being higher or lower. The orange line is the 90th percentile where 10% of survival differences are higher and 90% are lower.

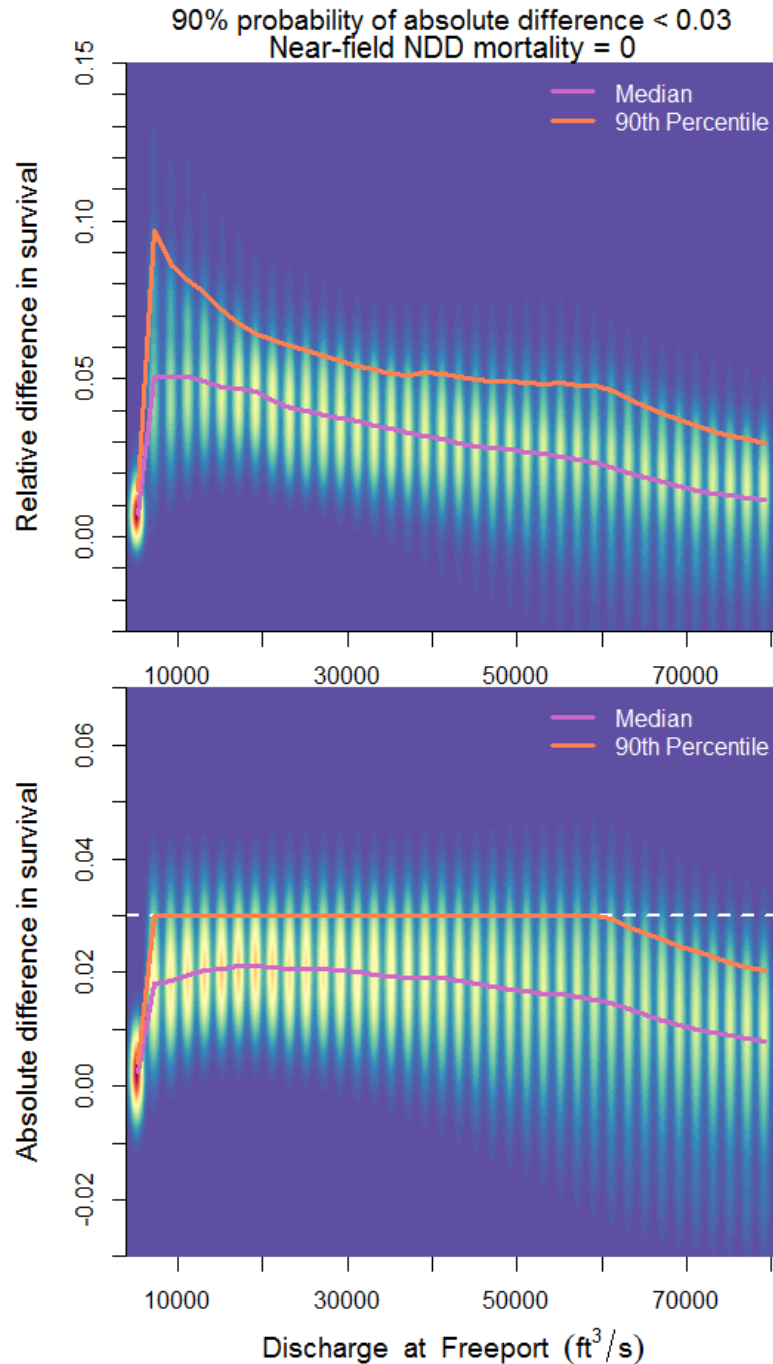


Figure 11.28. Posterior distributions for the relative (top graph) and absolute (bottom graph) difference in survival between no diversion and diversion at rates based on a criterion of a 90% probability of an absolute difference in survival of 0.03 with zero near-field mortality. Each vertical color band is the posterior distribution of the survival differences that were calculated in increments of 2,000 ft^3/s for the Sacramento River at Freeport. Darker colors (red) indicate regions of higher probability and lighter colors (yellow) indicate lower probability. The pink line marks the median difference in survival where there is a 50% probability of the survival difference being higher or lower. The orange line is the 90th percentile where 10% of survival differences are higher and 90% are lower.

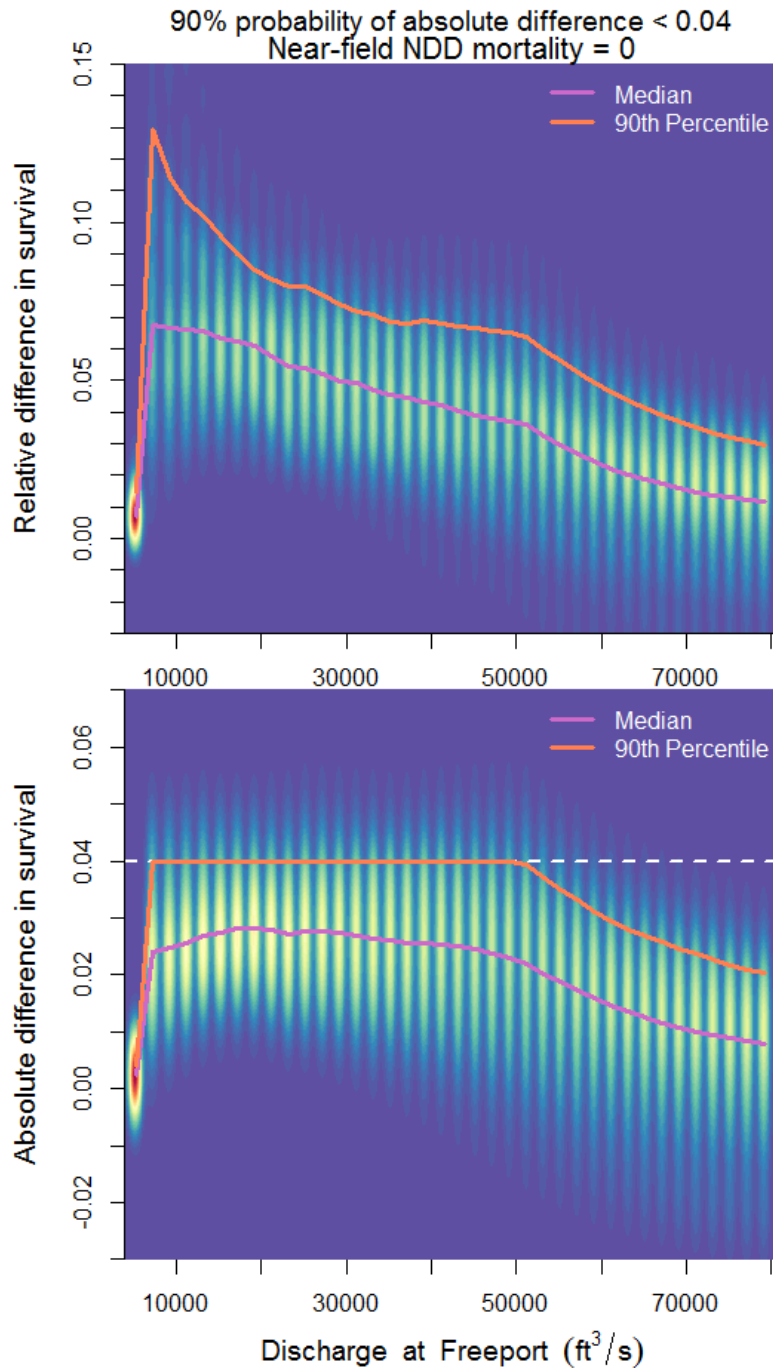


Figure 11.29. Posterior distributions for the relative (top graph) and absolute (bottom graph) difference in survival between no diversion and diversion at rates based on a criterion of a 90% probability of an absolute difference in survival of 0.04 with zero near-field mortality. Each vertical color band is the posterior distribution of the survival differences that were calculated in increments of 2,000 ft^3/s for the Sacramento River at Freeport. Darker colors (red) indicate regions of higher probability and lighter colors (yellow) indicate lower probability. The pink line marks the median difference in survival where there is a 50% probability of the survival difference being higher or lower. The orange line is the 90th percentile where 10% of survival differences are higher and 90% are lower.

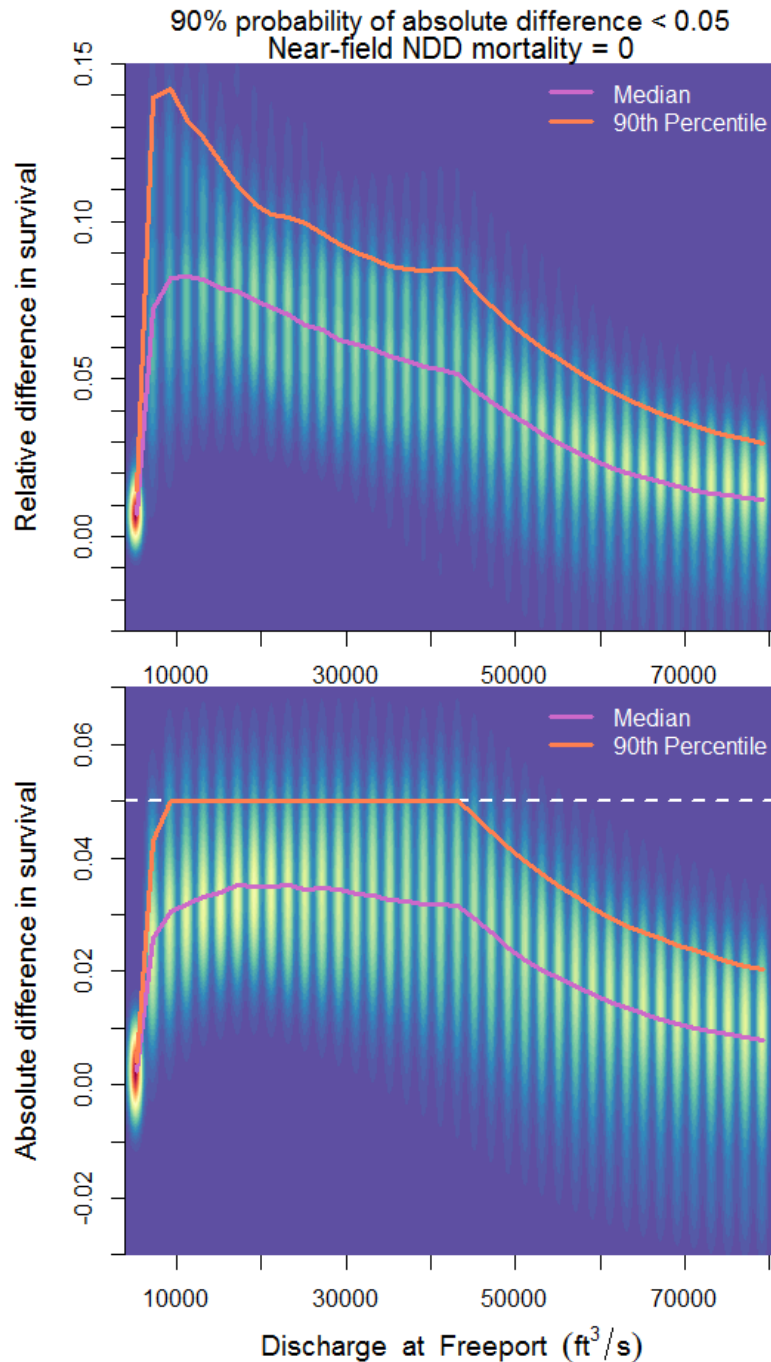


Figure 11.30. Posterior distributions for the relative (top graph) and absolute (bottom graph) difference in survival between no diversion and diversion at rates based on a criterion of a 90% probability of an absolute difference in survival of 0.05 with zero near-field mortality. Each vertical color band is the posterior distribution of the survival differences that were calculated in increments of 2,000 ft^3/s for the Sacramento River at Freeport. Darker colors (red) indicate regions of higher probability and lighter colors (yellow) indicate lower probability. The pink line marks the median difference in survival where there is a 50% probability of the survival difference being higher or lower. The orange line is the 90th percentile where 10% of survival differences are higher and 90% are lower.

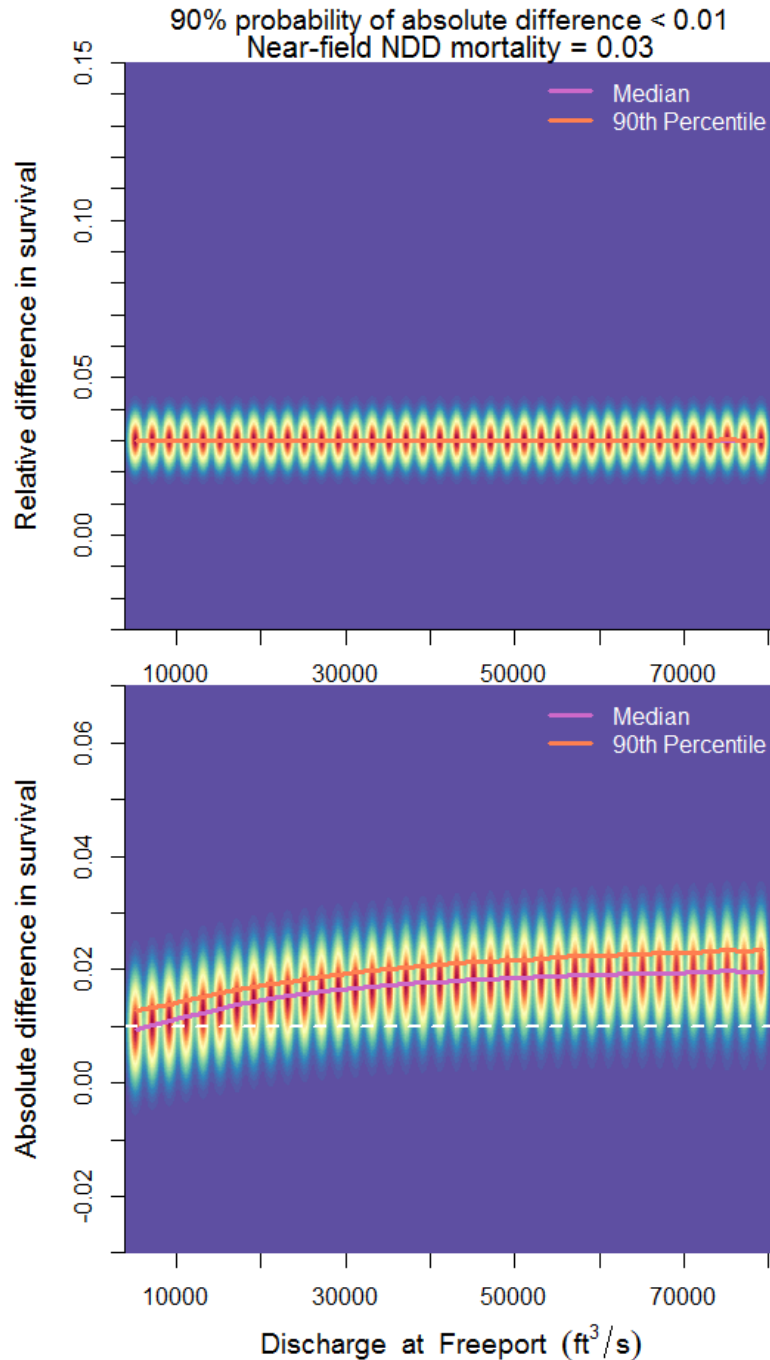


Figure 11.31. Posterior distributions for the relative (top graph) and absolute (bottom graph) difference in survival between no diversion and diversion at rates based on a criterion of a 90% probability of an absolute difference in survival of 0.01 with near-field mortality of 0.03. Each vertical color band is the posterior distribution of the survival differences that were calculated in increments of 2,000 ft^3/s for the Sacramento River at Freeport. Darker colors (red) indicate regions of higher probability and lighter colors (yellow) indicate lower probability. The pink line marks the median difference in survival where there is a 50% probability of the survival difference being higher or lower. The orange line is the 90th percentile where 10% of survival differences are higher and 90% are lower.

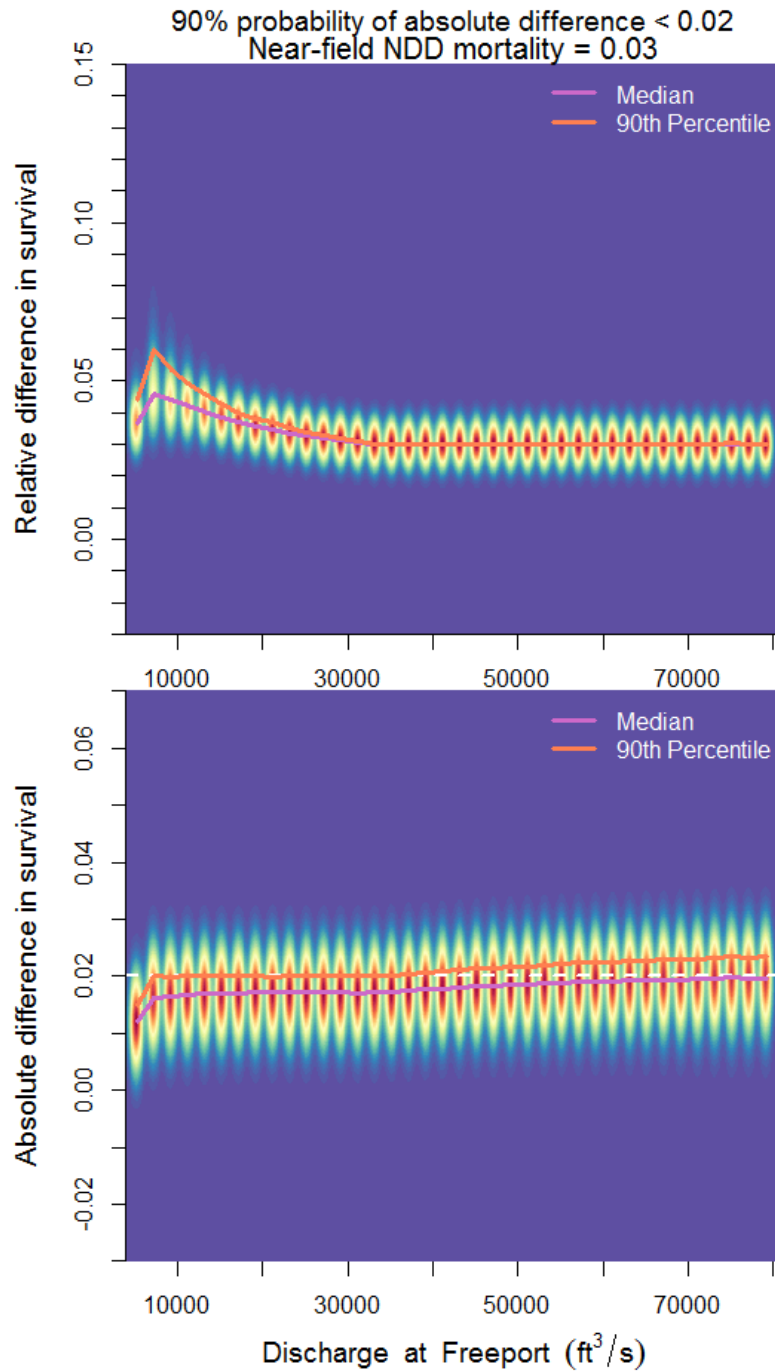


Figure 11.32. Posterior distributions for the relative (top graph) and absolute (bottom graph) difference in survival between no diversion and diversion at rates based on a criterion of a 90% probability of an absolute difference in survival of 0.02 with near-field mortality of 0.03. Each vertical color band is the posterior distribution of the survival differences that were calculated in increments of 2,000 ft^3/s for the Sacramento River at Freeport. Darker colors (red) indicate regions of higher probability and lighter colors (yellow) indicate lower probability. The pink line marks the median difference in survival where there is a 50% probability of the survival difference being higher or lower. The orange line is the 90th percentile where 10% of survival differences are higher and 90% are lower.

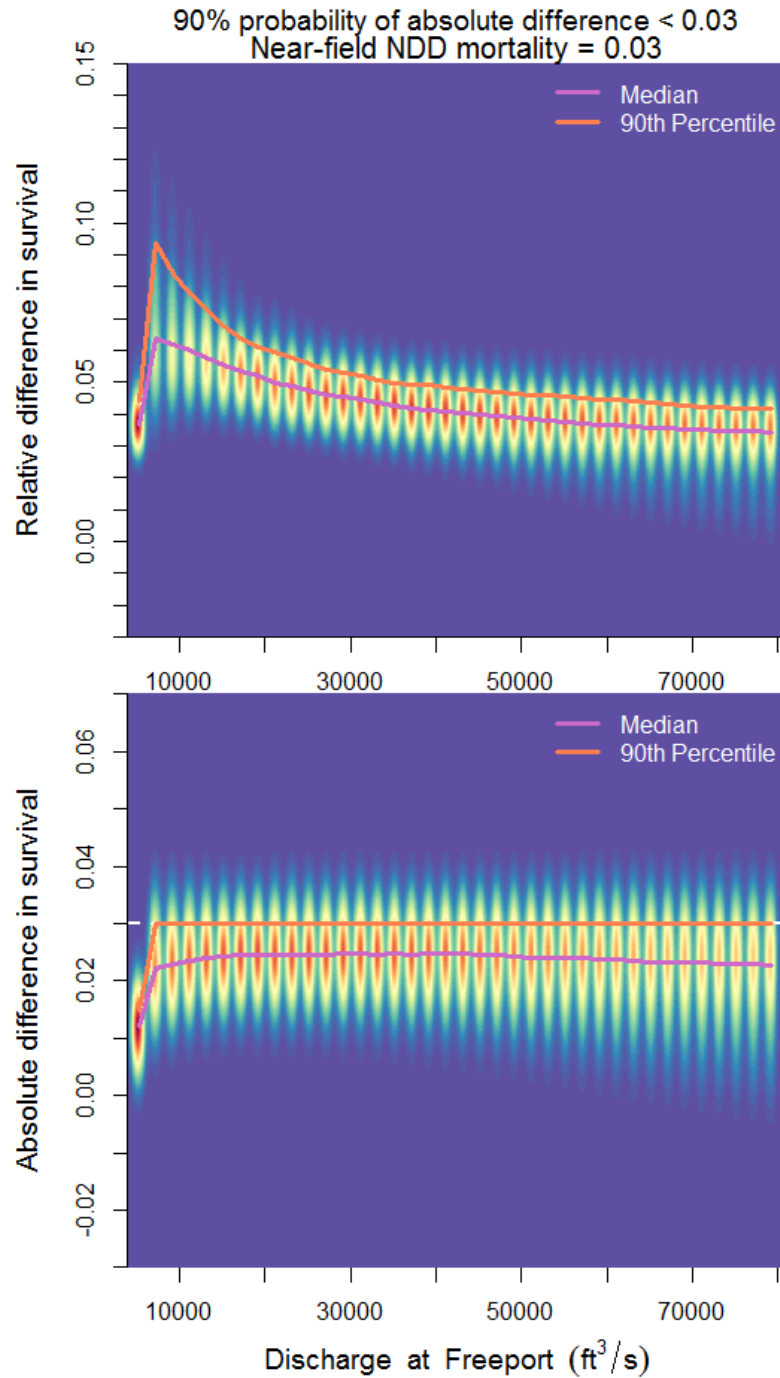


Figure 11.33. Posterior distributions for the relative (top graph) and absolute (bottom graph) difference in survival between no diversion and diversion at rates based on a criterion of a 90% probability of an absolute difference in survival of 0.03 with near-field mortality of 0.03. Each vertical color band is the posterior distribution of the survival differences that were calculated in increments of 2,000 ft^3/s for the Sacramento River at Freeport. Darker colors (red) indicate regions of higher probability and lighter colors (yellow) indicate lower probability. The pink line marks the median difference in survival where there is a 50% probability of the survival difference being higher or lower. The orange line is the 90th percentile where 10% of survival differences are higher and 90% are lower.

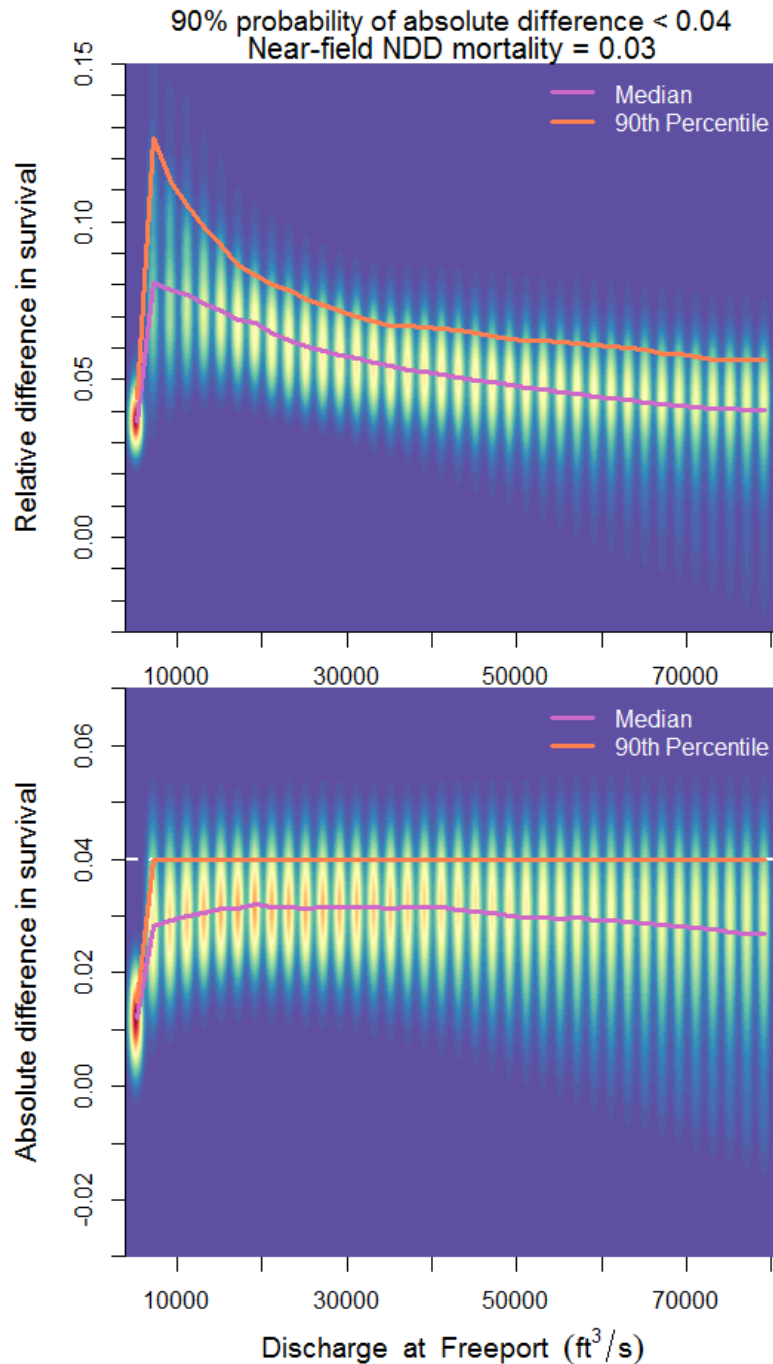


Figure 11.34. Posterior distributions for the relative (top graph) and absolute (bottom graph) difference in survival between no diversion and diversion at rates based on a criterion of a 90% probability of an absolute difference in survival of 0.04 with near-field mortality of 0.03. Each vertical color band is the posterior distribution of the survival differences that were calculated in increments of 2,000 ft^3/s for the Sacramento River at Freeport. Darker colors (red) indicate regions of higher probability and lighter colors (yellow) indicate lower probability. The pink line marks the median difference in survival where there is a 50% probability of the survival difference being higher or lower. The orange line is the 90th percentile where 10% of survival differences are higher and 90% are lower.

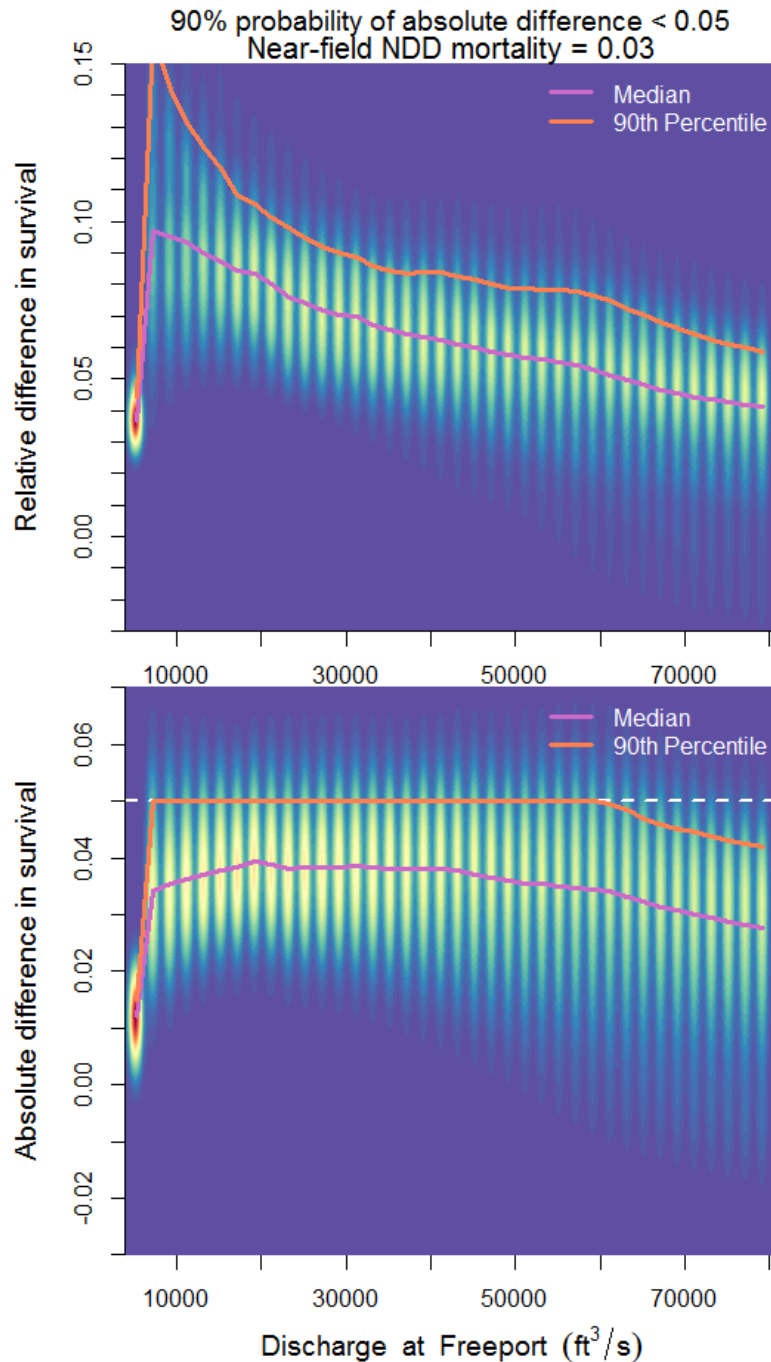


Figure 11.35. Posterior distributions for the relative (top graph) and absolute (bottom graph) difference in survival between no diversion and diversion at rates based on a criterion of a 90% probability of an absolute difference in survival of 0.05 with near-field mortality of 0.03. Each vertical color band is the posterior distribution of the survival differences that were calculated in increments of 2,000 ft^3/s for the Sacramento River at Freeport. Darker colors (red) indicate regions of higher probability and lighter colors (yellow) indicate lower probability. The pink line marks the median difference in survival where there is a 50% probability of the survival difference being higher or lower. The orange line is the 90th percentile where 10% of survival differences are higher and 90% are lower.

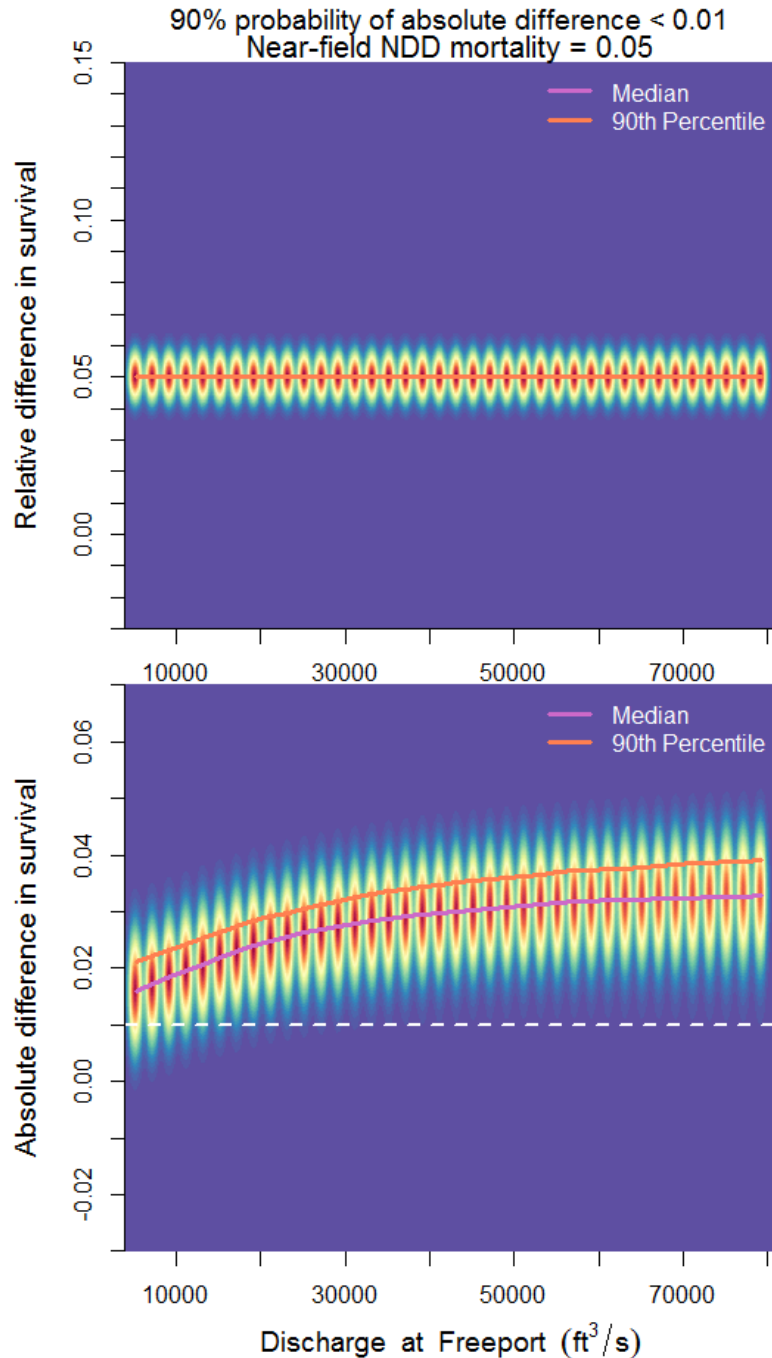


Figure 11.36. Posterior distributions for the relative (top graph) and absolute (bottom graph) difference in survival between no diversion and diversion at rates based on a criterion of a 90% probability of an absolute difference in survival of 0.01 with near-field mortality of 0.05. Each vertical color band is the posterior distribution of the survival differences that were calculated in increments of 2,000 ft^3/s for the Sacramento River at Freeport. Darker colors (red) indicate regions of higher probability and lighter colors (yellow) indicate lower probability. The pink line marks the median difference in survival where there is a 50% probability of the survival difference being higher or lower. The orange line is the 90th percentile where 10% of survival differences are higher and 90% are lower.

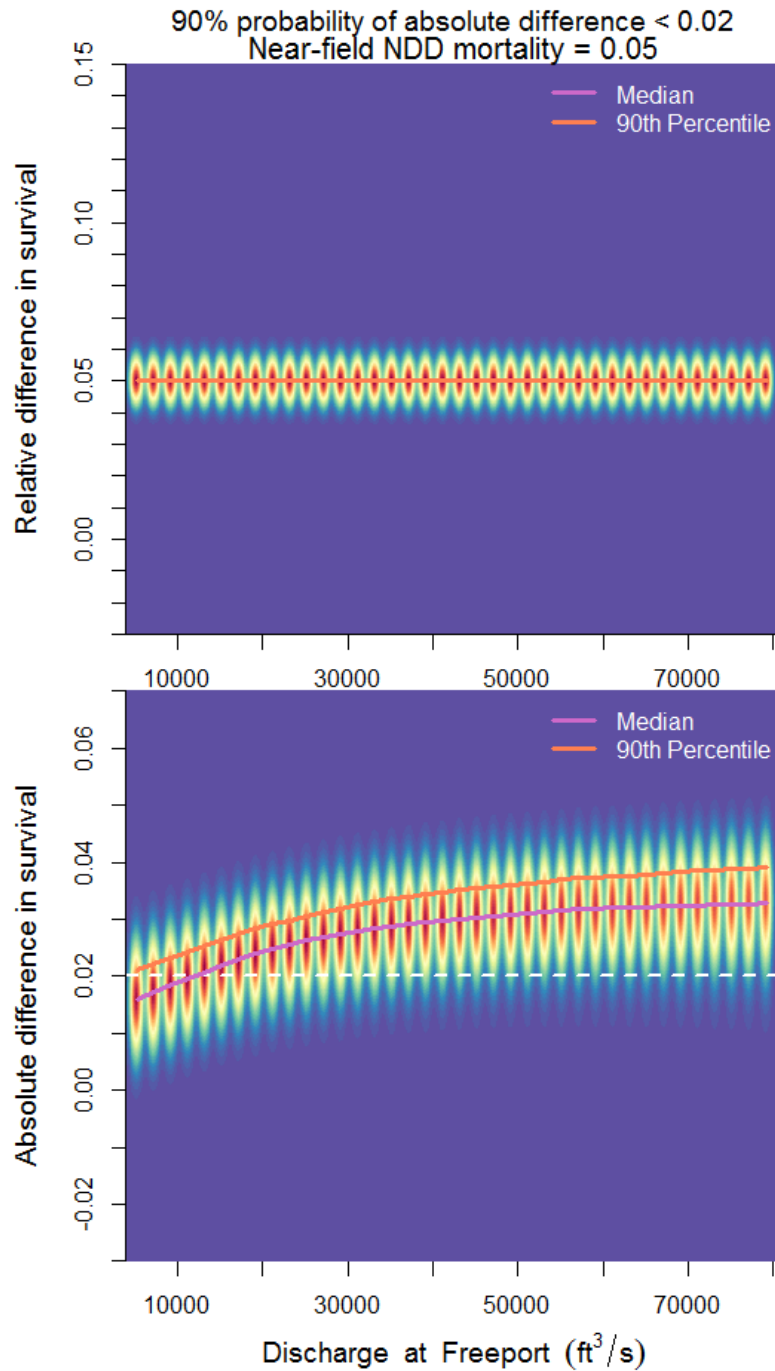


Figure 11.37. Posterior distributions for the relative (top graph) and absolute (bottom graph) difference in survival between no diversion and diversion at rates based on a criterion of a 90% probability of an absolute difference in survival of 0.02 with near-field mortality of 0.05. Each vertical color band is the posterior distribution of the survival differences that were calculated in increments of 2,000 ft^3/s for the Sacramento River at Freeport. Darker colors (red) indicate regions of higher probability and lighter colors (yellow) indicate lower probability. The pink line marks the median difference in survival where there is a 50% probability of the survival difference being higher or lower. The orange line is the 90th percentile where 10% of survival differences are higher and 90% are lower.

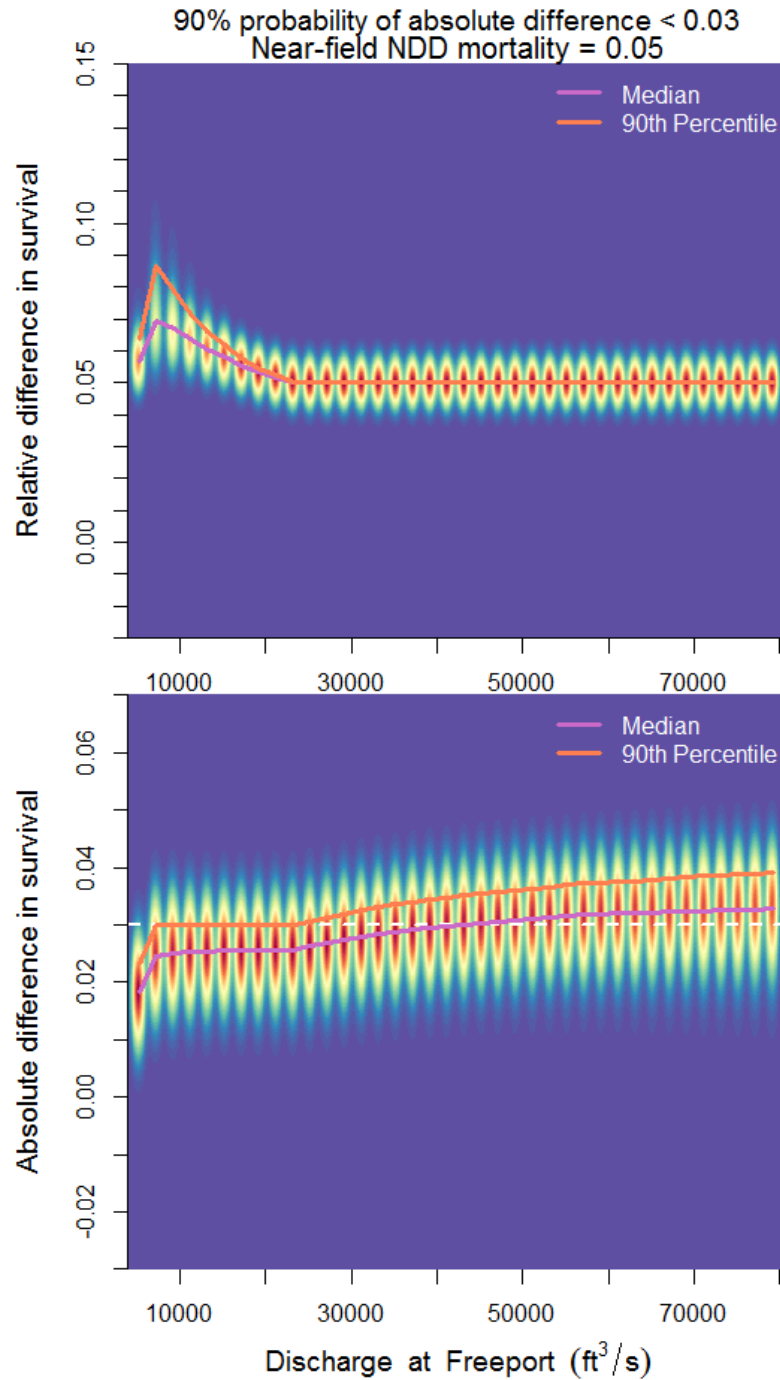


Figure 11.38. Posterior distributions for the relative (top graph) and absolute (bottom graph) difference in survival between no diversion and diversion at rates based on a criterion of a 90% probability of an absolute difference in survival of 0.03 with near-field mortality of 0.05. Each vertical color band is the posterior distribution of the survival differences that were calculated in increments of 2,000 ft^3/s for the Sacramento River at Freeport. Darker colors (red) indicate regions of higher probability and lighter colors (yellow) indicate lower probability. The pink line marks the median difference in survival where there is a 50% probability of the survival difference being higher or lower. The orange line is the 90th percentile where 10% of survival differences are higher and 90% are lower.

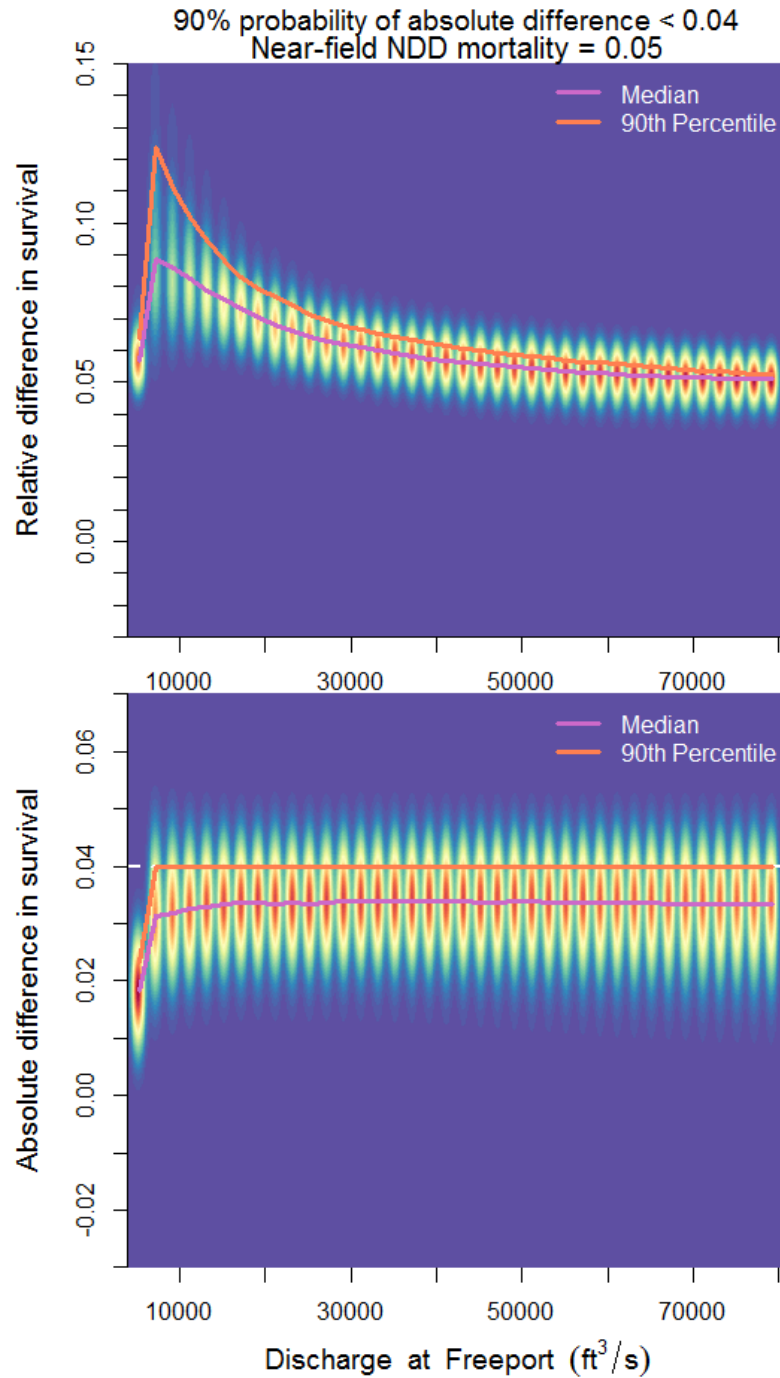


Figure 11.39. Posterior distributions for the relative (top graph) and absolute (bottom graph) difference in survival between no diversion and diversion at rates based on a criterion of a 90% probability of an absolute difference in survival of 0.04 with near-field mortality of 0.05. Each vertical color band is the posterior distribution of the survival differences that were calculated in increments of 2,000 ft^3/s for the Sacramento River at Freeport. Darker colors (red) indicate regions of higher probability and lighter colors (yellow) indicate lower probability. The pink line marks the median difference in survival where there is a 50% probability of the survival difference being higher or lower. The orange line is the 90th percentile where 10% of survival differences are higher and 90% are lower.

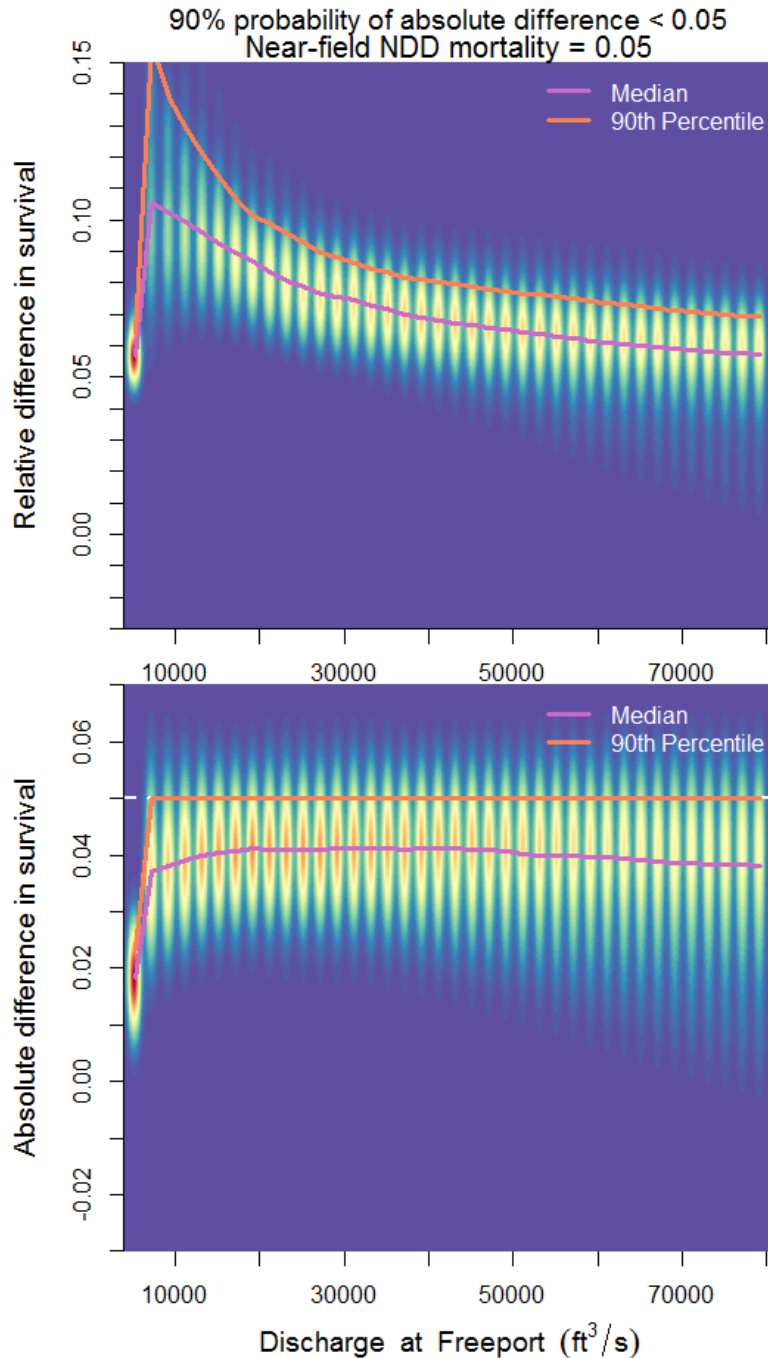


Figure 11.40. Posterior distributions for the relative (top graph) and absolute (bottom graph) difference in survival between no diversion and diversion at rates based on a criterion of a 90% probability of an absolute difference in survival of 0.05 with near-field mortality of 0.05. Each vertical color band is the posterior distribution of the survival differences that were calculated in increments of 2,000 ft^3/s for the Sacramento River at Freeport. Darker colors (red) indicate regions of higher probability and lighter colors (yellow) indicate lower probability. The pink line marks the median difference in survival where there is a 50% probability of the survival difference being higher or lower. The orange line is the 90th percentile where 10% of survival differences are higher and 90% are lower.